11-1-2012

Digital Media's Transformative Role in Education: Beyond Potential to Essential

Ming-tso Chien

University of Denver

DIGITAL MEDIA'S TRANSFORMATIVE ROLE IN EDUCATION: BEYOND POTENTIAL TO ESSENTIAL

A Dissertation

Presented to

The Faculty of the Morgridge College of Education

University of Denver

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

---

by

Ming-tso Chien

November 2012

Advisor: P. Bruce Uhrmacher, Ph.D.

Author: Ming-tso Chien
Title: DIGITAL MEDIA'S TRANSFORMATIVE ROLE IN EDUCATION: BEYOND POTENTIAL TO ESSENTIAL
Advisor: P. Bruce Uhrmacher, Ph.D.
Degree Date: November 2012

ABSTRACT

Achieving effective learning via digital media continues to be a major concern in contemporary education. The daily use of all forms of digital media is part of our lives and therefore becomes a key *component* of education. Educators must consider the process of digital media curriculum as a learning model and form of experience adapted to education. This means the significance is on *how* to learn as well as *what* to learn. This study demonstrated how the implementation of digital media curriculum via the Scratch game-making project contributed to middle school students' interaction with the entire educational process. The goal was to rethink the role of digital media in transforming schooling. Based on classroom observation and interviews with the teachers and students from four middle schools in Denver, Colorado, the qualitative method of educational criticism and connoisseurship was employed to examine the use of digital media and the interaction between teaching and learning. Several themes emerged: (a) The production of digital media influenced students' behavior and educators' attitudes towards formal and informal learning; (b) digital citizenship is a substantial lesson in the course of digital learning and an understanding of the digital framework of society; (c) new literacy is critical, because ever-changing equipment supporting the digital experience provides dynamic and contrasting ways of connecting with society; (d) the reward of learning is by doing versus being told, and deeper learning is attained by students' interacting with their

own work; and (e) digital media programs, such as making video games for learning, provide students skills in communication, theoretical, aesthetic, creativity, and technical knowledge necessary for becoming successful digital citizens. The research revealed students' enjoyment and effort in this new form of learning experience, which enhanced their critical thinking, problem solving, and creativity under teachers' well-planned guidance. The challenge for educators is to constantly review and design educational approaches supporting students towards using the tools meaningfully and within a defined learning experience, continuing to help students become active participants and authors of their own identity and creativity. Educators need to find the best usage of digital media technology, providing students every advantage towards reaching an informed global perspective.

ACKNOWLEDGEMENTS

I want to thank my friends and families for putting up with me during this process. Their endless love and support have allowed me to complete the following study. Of course I need to thank the inventions of Facebook and mobile phone, so my dearest friends can constantly show their care and drag me away from the Mac. My mother deserves my deepest gratitude for her continued understanding and enthusiasm for my assortment of projects and dreams. I wish also to thank my sweetheart, Sweet-Pea, who always provides me with such attention every step of the way.

I would like to thank my advisor, Dr. P. Bruce Uhrmacher, for his encouragement and direction throughout this process. With his wisdom and guidance, I have learned more about the field of education and gained confidence to continue my journey. I also want to sincerely thank the other members of my committee, Prof. Rafael Fajardo and Dr. Paul Michelec, for their invaluable contribution and time. Their feedback and intelligence have strengthened my own beliefs to reach the higher quality of our profession.

Most importantly, I wish to express my deep appreciation to the teachers who so graciously opened up their classrooms and themselves to my study. And, I am most certainly grateful for the students in the four classrooms who accepted me as part of their class and were open and honest with me. They gave willingly of their time to reveal their thoughts, which were an invaluable sharing of their experience and central to my work.

Confucius said “Real knowledge is to know the extent of one’s ignorance,” and I know that my journey of learning and discovery has just begun. Yet, I must leave to get some cat food now—Sweet-Pea always remind me her quote is thus, “eat, play, sleep.”

TABLE OF CONTENTS

CHAPTER ONE:

INTRODUCING THE STUDY

Introduction

> This is a generation that learns differently, and unless we recognize and accept those differences, we will turn them off education. They are ready and willing to be the future, but we have to engage them in ways that we have never imagined could be part of school (Rosen, 2010a, p. 49).

In early January 2010, the point made by author, Stone (2010), in *The New York Times* article, “The Children of Cyberspace: Old Fogies by Their 20s,” caught my attention. The author discussed how his 2-year-old daughter identified the Kindle e-book[1] as a substitute for words printed on physical pages and mastered it as well or better than her parents. There is no doubt that today’s young generation has a very different worldview and experience than their parents, which leads the way in using digital media to blur the boundaries (Collins & Halverson, 2009) between how people live and relate to one another and to the world around them (Palfrey & Gasser, 2008). As technologies

[1]Kindle book is also called e-book reader. More precisely, it is a software and hardware platform developed by Amazon.com for the rendering and displaying of e-book and other digital media.

continue to change at an even more rapid pace, children have contrasting awareness of media technologies, with each group of children uniquely influenced by the technological tools available in their formative stages of development (Stone, 2010). Mini-generations (Rosen, 2010b) or subsets of full generations are defined by their distinctive patterns of media use, levels of multitasking, and preferred methods of communication. Among these mini-generations, differences are also being found in their values as well as in their levels of social and political activism. Those who were born in the 1990s have been called the I-Generation (Rosen, 2010a), and Net Generation (Tapscott, 2009), sometimes referred to as Digital Natives (Palfrey & Gasser, 2008). There is an entire set of technological references to those born after the 1980s. Recently, Mark McCrindle of McCrindle Research stated that babies born after 2010 form the Generation Alpha ("Babies Born From 2010," 2009). But what does it all mean?

These young people are different (Palfrey & Gasser, 2008). They study, work, write, and interact with each other in ways that are very different from the ways that we did growing up (Palfrey & Gasser, 2008). These generations are multitaskers (Wallis, 2006). Rosen indicated that teenagers usually can perform seven tasks in real time, such as texting[2] on their phone, sending instant messages to several people, and checking Facebook[3], while sitting in front of the television. This compares to people in their early 20s who can handle only six discrete tasks and those in their 30s who can perform only about five and a half (as referred to in Stone, 2010).

---

[2]Texting refers to the exchange of brief written messages between fixed-line phone or mobile phone and fixed or portable devices over a network.

[3]Facebook is a social network service and website launched in February 2004 that is operated and privately owned by Facebook, Inc.

Children tend to express themselves creatively in ways that are very different from the ways their parents did at their age (Palfrey & Gasser, 2008). Many children are "creators" every day of their lives (Palfrey & Gasser, 2008). They make their own YouTube videos, post photos, mash up music, create multimedia presentations, and frequently develop personalized content (Rosen, 2010b). All in all, they demonstrate more fluidity with and dependency on technology than did any previous generation.

While reading that article in *The New York Times,* I kept thinking that our children learn differently in a digital world. This generation grows up with various technologies integrated into their daily lives. Whereas we consider that the computer, cell-phone, Wii[4], Facebook, or texting are substantial inventions, the young generation lives seamlessly with these devices and the advances in living and learning that they provide. We, as educators, need to understand how members of today's young generation integrate technologies into life, study, and work, and what they expect to do with and receive through them, as well as what is expected of them in their education. Each mini-generation is showing itself to be different—in significant and discernible ways. The key in the evolution of education is to learn how educators can utilize these changes to effectively lead these students in the digital era.

In this study, I define *digital media* in the early 21st century as any electronic media that is created and displayed using computer technology, such as mobile devices, digital audio, digital video, and anything you would find on the World Wide Web. This

[4]Wii (pronounced /wiː/, like the pronoun we) is a home video game console released by Nintendo on November 19, 2006. A distinguishing feature of the console is its wireless controller, the Wii Remote, which can be used as a handheld pointing device and detects movement in three dimensions (*USA Today*, 2006).

includes computer games, Internet technology, communication (e-mail), social interaction (e.g., Facebook), and other technologies that can be used to create and distribute digital "content."

Why Study Digital Media Curriculum

One week later in *The New York Times*, Wallace (2010) discussed various elements of modern educational concepts held by Roger Martin, dean of the Rotman School of Management at the University of Toronto. Martin contended that a student's primary need is to "think different" by combining various approaches to finding innovative solutions through traveling multiple paths and with an overlay of critical thinking. The mission statement of the school sums it up: The Rotman School[5] is redesigning the curriculum for the 21st century with built-in "integrative thinking." (Wallace, 2010, p. 1). Martin starts by working integrative thinking into the curriculum and provides a space where students learn "a new way of thinking" (Wallace, 2010, p. 1). This echoes Trilling and Fadel (2009) in their book, *21st Century Skills: Learning for Life in Our Times*, in which they emphasized four powerful forces: (a) knowledge work, (b) thinking tools, (c) digital lifestyle, and (d) learning research. These concepts are converging and leading us toward new ways of learning for and about life in the 21st century. The technologies, which include digital devices and services, are considered "thinking tools" to fit an individual's need for innovative thinking (Trilling & Fadel, 2009).

---

[5]Located in the heart of Toronto, North America's third largest financial capital and the world's most culturally diverse city, the Rotman School is developing a new way to think that leads to creative business solutions (Jump Learning Lab, 2012).

The past several decades have produced rapid advances in computer technology and increased access to that technology within schools. For example, national and international statistics have shown that schools around the world are becoming increasingly better equipped with computer hardware (Mueller, Wood, & Willoughby, 2008; Pelgrum, 1992) and access to the Internet (Becker & Riel, 2000; Greene, 2000; Mueller et al., 2008). These trends and an educational evolution form the basis for change in contemporary education.

Throughout the 21st century, we should expect to see even higher levels of computer use that are no longer new (Mueller et al., 2008) and are quite literally embedded in the fabric of daily life. Students today use technologies to explore various information resources in and out of schools, and to approach "in the moment" information and news from real-time connections. Educators use technology to guide and engage students in self-directed learning activities and model problem solving, focusing on areas that are difficult to teach (Mueller et al., 2008). Learning is seen as a developmental thinking and practice process, and via these technologies, is enhanced by people around the world.

Students have opportunities to determine, challenge, change, or add to existing beliefs and understandings through engagement in tasks (Mueller et al., 2008; Richardson, 2003). Further, we know that technology has transformed our larger society. It has become central to the act of reading, writing, communicating, and thinking, which are major concerns of schooling (Collins & Halverson, 2009). It has been suggested that with the integration of a digital media curriculum into schooling, today's students will have more opportunity to express what they have learned in core subjects and express their knowledge well beyond yesterday's standard paper report.

One of most influential pioneers in education, Tyler (1949), emphasized how critical it is to analyze the notion of contemporary in the context of achieving the objectives of education. Ornstein and Hunkins (1988) highlighted that educators need to consider planning today for education tomorrow to keep pace with the rapid change of society. The first reason for doing this study is that society is continually changing, and educators need to acquire the most current skills and important knowledge. The second reason is society itself grows out of findings related to the transfer of knowledge through training. Students would be able to use this training to meet the conditions of their environment and any challenges or problems they encounter. Digital media in education are more than just a trend; they are an essential addition to the utilization of technology in contemporary life. Digital media put the theory of technology integration into educational practice. Although we have no clue about the *when, where*, and *what* of the next new creation, the changes and advances in technology have taken our communication and interpretation to a new form of language by opening up exciting and unlimited creative experimental opportunities.

While considering the integration of digital technologies in teaching and learning, the depth of the digital divide is best reviewed as to how the technology is being used, or whether educators and students recognize this integration and the multitude of available uses it offers to take advantage of these technologies (Wood & Willoughby, 2008). That is to say, the centrality of technology in students' lives defines the depth of their present-day learning experience. The extent to which the digital divide takes place is evident where students realize the integration of technology as an important part of their interaction with culture and society compared with socioeconomic circumstance or by intentional curriculum choices. According to Wood and Willoughby (2008), “Whereas the width of this divide has received a lot of attention, awareness of the scope and depth of the digital divide is just now becoming prominent” (p. 300). Other scholars, such as Akhter (2003), Driori and Jang (2003), and Jung, Qui, and Kim (2001), have also supported this view.

It is essential to describe digital media and modern technology as a means for creating a new approach to learning. The purpose for using these technologies in education is not to prepare students for careers as professional computer engineers, but to nurture a new generation of creative, divergent thinkers who are comfortable using digital media to express their ideas. The purpose of this study is to describe and analyze how the implementation of digital media curriculum may specifically contribute to middle school students’ interaction with the entire educational process. The study also looked at why digital media study has value in facilitating students’ engagement in lifelong learning. My goal is to provoke a rethinking of the role that digital media can have in reforming schooling.

Conceptual Framework

In his preface to the book, *Technology in Education: Looking Toward 2020*, Zodhiates (1988) indicated that context influences not only what people learn, but why and how. His comments in this preface that referred to salient observations of the book’s chapter authors are as follows: Landauer stated that the role of education may be changed by new ways in which people will interact with the world, and technology will become a cognitive tool to help people to know, think, or learn. Gardner "envisioned using technology to individualize the education of students who come to school with a variety of skills and predispositions" (as cited in Zodhiates, 1988, p. xi). In diSessa's view, technologies serve two functions: "One is as an intrinsically motivating educational device; the other is as a medium of invention and construction" (as cited in Zodhiates, 1988, p. xi). DiSessa reminded us that a large part of students' enjoyment and sense of accomplishment, both in school and out, comes from achieving competent performance in the building of things. According to Feurzeig, "computer technologies can introduce students to formal thinking procedures in the context of playful activities and allow them to become active practitioners in the area of procedural discipline" (as cited in Zodhiates, 1988, p. xii). Cohen pointed out that technology does not drive change but provides opportunities for change. And finally, Nickerson concluded in Zodhiates's preface that the immediate future and beyond will require the collaborative efforts of technologies and educators in the coupling of technology-based tools with other teaching/learning resources, so as to support an integrated approach to specific subject matters in the classroom.

Digital technology relates to education in many ways. The connection with educational methods and practice is one of them. Education takes place within a sociocultural context, the nature of which is determined by digital media as much as by anything else. Digital technology—its role as an agent of social change—is key in shaping students. "Digital technology also affects the content of education, because among the objectives of education is that of making understandable the world in which one lives, and we live in a digital world" (Nickerson, 1988, p. 285). Accordingly, learning takes place through the interplay between the elements of multifaceted thinking, motivation, engagement, experience, creativity, and their variables. These elements are inseparable from the core fundamentals of learning. Through my study, I learned the significance of these elements in digital media curriculum studies.

Multifaceted Thinking

There are many definitions for the concept *multifaceted*. In relating it to thinking, I define it as a form of thought that results in diverse responses when a person is introduced to a single subject through a variety of media. Contemporary methods of experience and learning, particularly when digital media is used, enable—in fact often require—the learner to receive and transmit information across a wide range of sources and types of media. *Multifaceted thinking* describes the modern environment where learners, teachers, and life itself no longer follow a singular track but embrace a multitude of inputs and outputs. In this study, I followed the idea of Dewey (1934) and Eisner (2002) in characterizing multifaceted thinking as follows: When a person interacts with the environment and chooses to express him or herself in two forms of representations (modalities) or more, then he or she is involved in multifaceted thinking.

Incorporating digital media into the contemporary thought process is further affected by the constant and rapid evolution of the technologies of transmission. Multifaceted thinking incorporates the magnitude and speed of these changes in ways that can be highly motivational and thought provoking. This capability to foster multifaceted thinking can be applied to education in a way that enhances an individual's creativity in all facets of life.

Multifaceted thinking encourages the search for new data, the pursuit of new forms of information gathering, processing, and sharing. It is a thinking process that pushes the exchange of information at the same accelerating pace as the medium itself is changing, and it gives the user the ability to keep up with and often stay ahead of trends and new forms of expression. It can foster a new era of creativity.

When we read, write, or draw in a sketchbook, we are familiar with the process: We read from page one to page two, from left to right in English, and from top to bottom. However, working on a project based in the digital media environment (e.g., video games, digital story, or websites) is very different. The user has to consider a wide range of possibilities in creating or using the materials. For example, the transition, size, color, sound, and speed of animation become more varied in the digital environment when compared to the analog world.

To compare the two concepts of linear and multifaceted thinking, *linear thinking* has been defined as a process of thought following known cycles or step-by-step progression, where a response to a step must be elicited before another step is taken ("linear thinking," n.d.). Barry (1997), in the book, *Visual Intelligence: Perception, Image, and Manipulation in Visual Communication*, proposed an example of multifaceted thinking in the art form of origami. Using origami to solve the problem not only produces more practical designs. It also can provide an approach to more easily solve sophisticated design problems by utilizing visual perceptual skills and the parallel mental processing that this three-dimensional perception affords. A different example would be a boy who normally answers the question directly and straight forwardly based upon what the teacher has taught him (Gleick, 2011) and in serial fashion, that is, one step after another.

It is not so much that he follows instructions step by step but that, in the linear model, he would focus only on the particular task at hand, such as drawing a circle versus thinking about what the circle represents, the options for drawing a circle, and so on.

The digital information environment is dynamic; multimedia sources combine several media, such as text, graphics, animation, audio, and video, in an integrated format(s) accessed by a wide range of digital devices (Orr & Fankhauser, 1996). While working in the digital environment, the learner learns to operate utilizing the concepts of *multifaceted thinking*. For example, when we design a paper greeting card, we would draw characters and design a scene with a title. The development of the card moves at the slower pace of the linear thought process, in a serial or step-by-step manner. Creating an e-card in the digital environment, the designer has to contemplate the possibility of animations, sounds, and transitions from one movement to another; timing; and several unexpected possibilities arising from the dynamic way the user interacts with the card. Another example would be a website we browse on the Internet. Some websites allow the reader to click an index or menu on the page; and whereas the information they are seeking is found, it may be accompanied by an unexpected animation, text, or sound, causing them to experience this data in new ways. It is the producer's attempt to help readers to scrutinize the information in their own order and according to their own priority. In this way, we have experienced reading a website as if it were a story but would actually be able to move dynamically within and around the story.

Learning in the digital media environment and solving problems on the computer screen is different when compared to the traditional classroom where students read and write with pen and paper. Students might become excited by the prospect of digital delivery and develop new and unusual forms of presentation for their project as they interact with a dynamic distribution model versus the stationary delivery of pen and paper. Or, they could become nervous and over-think the transition from plain paper to the computer screen. A key element of my research was learning more about students' multifaceted thinking in various forms of representations, as they approach the digital media environment.

There are various techniques where students may explore their multifaceted thinking. In this study, my focus was on the students' reaction when the teacher introduced the project and students started working within the digital environment, including the work process and final presentation. I researched the process and its elements of intent and engagement, as well as the varied forms of presentation and the result. I catalogued many points of observation, such as whether students figured out what they wanted to do for their project in a relatively short time or if the digital environment created new learning challenges, difficulties, and obstacles when compared to the analog or pen-and-paper model. I also questioned if students became multifaceted thinkers or remained reliant on linear thinking throughout the processes of learning in the digital media environment.

Motivation

Previous studies have found that the motivational orientation of students has significant impact on their learning performance (Pintrich & De Groot, 1990). Classrooms with students having higher levels of motivation demonstrate lower dropout rates, higher-quality learning, better learning strategies, and more enjoyment of school (Carlton & Winsler, 1998; Czubaj, 2004; Deci & Ryan, 1985; Kauffman & Hussman, 2004; Moneta, 2004; Rau, Gao, & Wu, 2006). If students are always ready to learn and enjoy a range of subjects as motivated individuals, learning is positively impacted. Motivation is more about students' internal sense and self-empowerment, because it makes them eager to learn and keep working through challenging processes, stimulating the self to produce their best work. Several researchers believed digital media motivates students via fun and is a part of a process that creates a contemporary form of engagement with the subject, which translates to motivation (Buckingham, 2007a). I interviewed students to learn more about an individual's motivation to continuously search for the best possibility to achieve and strive for the best result.

As with intuition, uncovering the levels and quality of motivation was focused on the appearance of fun, pleasure, and how engrossed the student was in his/her work and, ultimately, concerned with the final result or work product. One way this can be observed is in students' levels of focus and how they track time at their task. Probing deeper into the subject matter with more self-guided research and showing an eagerness to pursue more detailed knowledge represents but one potential demonstration of increased motivation. I watched for these factors and more in my research, particularly where such factors could be attributed to the use of digital media.

Engagement

Engagement is a form of participation that suggests that students keep learning, be involved with the classroom, and actively contribute to the effort at hand. According to Uhrmacher (2009), active engagement requires that students be in the driver's seat; they are at the helm of their own learning, that is, intellectually creating meaning or making choices about how to represent their knowledge. A number of researchers have documented the lack of student engagement in the classroom. If students possess the motivation to learn about a subject or project, they might however have a lack of the engagement needed to be an active and engrossed participant in classroom learning. It is not that they do not want to learn; they want something different to spark their participation (Rosen, 2010a). Today's students are constantly exposed to the Internet and other digital media, inspiring how they receive information and how they learn. But, there are different degrees of engagement to guide students to continuously keep learning. In this study, I learned how the use of digital media curriculum and the digital environment creates and sustains active engagement between the subject and the learner. It is important that educators provide a comfortable environment to encourage students' active engagement with a project, peers, and the classroom, and there may be ways a digital atmosphere facilitates that increased comfort. In the present study, I sought to determine if classroom environment, mentors, and other forms of coaching were also critical for fostering students' engagement, and at what levels when compared with digital media. I also explored if the "stickiness" of—the strong attraction of students to continually want to use—digital media could be a key part of engagement.

The methods of sizing up how engagement is fostered and then manifests itself in the work product of students may be observed in various ways. For example, it may be noted in the amount of time students voluntarily devote to a task and how they apply increasing degrees of focus—targeting their work to the optimal result.

Experience

Experience is a relational concept: neither objective nor subjective, but expressing a relationship between a person and a phenomenon (Ellis & Goodyear, 2010). Today's learners live, work, and learn in a world that is saturated with digital technologies. Many younger learners—the so-called “iGeneration” or “Digital Natives”—expect instant access to media, information, and communications. Students’ learning experience could be different because of the digital media classroom environment or personal background. Several researchers have commented that learners showed a variety of attitudes as they approach digital technology for learning, communicating, or fun. Uhrmacher (2009) indicated that learning experiences can be ordinary or extraordinary, and the difference is often found where the educators provide exemplary situations and environment. My study focused on students’ approach to learning in a digital media environment and demonstrated how the students’ experience is important to their assimilation of knowledge.

Creativity

In today’s rapidly changing world, the ability to think and act creatively in response to the unexpected is increasingly valued. A need in the 21st century is to help learners develop more creative minds, because creativity is critical to success and satisfaction in today’s society (Resnick, 2007a). In short, we are now living in a creative society where ingenuity and inventiveness are required. New technologies play an important role in a creative society. On one hand, the rapid growth of new technologies is quickening the pace of change and the need for creative thinking in all aspects of people’s lives. On the other hand, digital technologies, if used properly, have the potential to help people develop as creative thinkers who are better prepared for life in such a society. Creativity has always been seen as a successful outcome of education.

Bowers (1995) emphasized that creativity directly corresponds with the rate and level of change in contemporary society.

Kaufman, Plucker, and Baer (2008) suggested one way of organizing creativity research is via the “Four P” model, which distinguishes the creative person, process, product, and press. Study of the creative person may look at individual characteristics of the creator. These areas may include personality, motivation, intelligence, thinking style, emotional intelligence, or knowledge (Baer & Kaufman, 2005; Sternberg & Lubart, 1995). Moreover, individual creativity can be affected by personality, reward, and criticism (Berger & Ferguson, 1990), and by environmental stimuli, including time pressure, evaluation of work by others, fear of disturbing the status quo, and political constraints (Amabile, 1988).

Amabile (1983, 1995) proposed that three variables are needed for creativity to occur: domain-relevant skills, creativity-relevant skills, and task motivation. Domain-relevant skills include knowledge, technical skills, and specialized talents that individuals might possess that are important in one particular domain, but not in others. Creativity-relevant skills are personal factors, such as tolerance for ambiguity, self-discipline, and a willingness to take appropriate risks. The third component in Amabile’s model singles out one’s motivation toward the task at hand. Intrinsic motivation, being driven by enjoyment of a task, is more associated with creativity than extrinsic motivation or being driven by external rewards, such as praise (Baer, 2008).

The creative process is the actual experience of being creative. It comes when an individual is intensely engaged in an activity. Many assessments focus on creativity-relevant skills or processes. As with assessments of persons, assessments of skills or processes can look at creativity-relevant thinking skills more generally. Amabile (1996) has done studies that consider the importance of creativity as being driven by a passion for the activity. For example, people who enjoy the work will also be more creative. Studies of the creative press (or environment) are often designed to determine how the context in which one works or studies may be modified to encourage people to be more creative. Amabile focused on the motivation of social judgments by encouraging participants to create products that were subsequently rated by expert judges for evidence of creativity. In his words, "A product or response is creative to the extent that appropriate observers independently agree it is creative" (p. 33). Craft (2000) pointed out that changes in information and communication technology bring enormous possibilities to schools and may open many new doors to students. Creative people will be a valuable resource in the rapid process of change (McLeod & Cropley, 1989), and creativity learning in students needs to be encouraged so that they become successful members of society (*Education in Action*, 2011).

In my study, I focused attention on the definition that Baer et al. (2008) proposed in the book, *Essentials of Creativity Assessment*: "Creativity is the interaction among aptitude, process, and environment where an individual or group produces a perceptible product that is both novel and useful as defined within social context" (Plucker et al. as cited in Baer et al., 2008, p. 1). The increased use of digital technology might both enable and induce students to learn to develop their multifaceted thinking in a learning process where they try it out, test the boundaries, experiment with alternatives, get input from others, and generate new ideas based on their experience.

In this study, I explored how students' creativity is fostered by and molded in a digital media-learning environment, and subsequently I analyzed these influences. It is not only about an individual thinking style, students' motivation for their work, the entirety of the creative process, the learning event, and a beautiful final project, but how digital media provides a distinct form of learning in contemporary life.

In summary, having to overlay the elements of multifaceted thinking, motivation, engagement, experience, and creativity onto their work could force teachers and learners into adding yet more work. They might perceive this as both distracting to the core mission and counter to the task at hand. These are individual elements but must be considered as a whole for the creative learner in contemporary society. In my study, I did not make any judgments or comparisons from one individual to another. Instead, I shared my observations and conducted my interviews based upon the definitions I have explained above.

Significance of the Study

First, my study emphasized the acceptance and results of integrating digital media curriculum into modern schooling. The use of technology in school has been emphasized by other researchers and in other forums and venues. But educators must be aware that the world is changing, which allows students to interact and develop thinking skills, problem-solving mastery, and technology construction (Abrami, 2001; Mueller et al., 2008; Saettler, 1990). Second, although many educators have advocated for educational reform, we, as educators, need to understand what is currently demanded by life and, in turn, function in today's society so that students have the opportunity to practice what they have learned in school and develop an approach to technology in contemporary life.

It is indeed related to Tyler's (1949) belief of understanding contemporary life in order to prepare students for the proper direction in learning and living. Third, whereas good teachers always strive to stimulate and propel their students though the experience of learning, this study provides an open window to invite educators to analyze my data and spark the possibility of integrating digital media curriculum into their schooling. Fourth, students generally find it enticing to use many forms of technology in their projects. Through this enticement and the resulting increase in motivation and engagement, students will have a higher quality result via their use of digital media and aesthetics. In turn, students' learning and development are enhanced. And lastly, this study sought to fully understand the commitment of today's educators regarding practice in these areas and where they see the application in education. An individual teacher's level of dedication to those practices will have a direct impact on the success of their implementation.

Overall, I hope my work will generate expectations promoting new ideas to benefit education and digital media curriculum in contemporary life. This study has allowed me to understand more of the educators' position as they consider integrating digital media curriculum into teaching and learning. Therefore, this study will help bring awareness and a valuable understanding of digital media curriculum and its use, based on my study of four teachers and their students' work regarding their intention to design and teach digital medial curriculum.

How Digital Media Curriculum Was Studied

One element of digital media is the convergence between interactive media, such as games, online networks, and existing media forms (Ito, 2007). Whereas a number of people consider digital technologies as tools for learning and seek to include more computers, whiteboards, and other existing learning software in their schools, it is important to consider how this digital technology is used. Indeed, because technology plays a dominant role in students' lives, it is important for them to be active participants instead of passive users and receivers. By teaching students basic computer skills and providing a comfortable digital environment, educators need to take into account the benefit of digital technologies and how students can receive knowledge from within the digital technology environment. Students need to cultivate the technological skills and achieve the resulting competencies needed for expressing their dynamic natural intuitive thinking and creativity.

About 25 years ago, Papert (1980) described the necessity of creating computer cultures rather than isolated experiences to learn with and about technology. In this study, I explored computer-aided instruction using the Scratch programming environment for students as a context for expressing personal inspiration and engagement. I then assessed the problem-solving skills that, as a result, were developed. Scratch, designed by the MIT Media Lab[6], is an educational programming language that allows people of any experience, technical background, and age to experiment with the concepts of a fully versatile digital media environment. Scratch is a program that can be easily used to create a multimedia presentation. Students can make projects that express themselves, and the framework of the Scratch curriculum encourages students to do so (Gorman, 2009). Students can access the digital environment, undertaking tasks in programming, graphics,

---

[6]The Massachusetts Institute Technology Media Lab.

.

music, and videos to construct games, create stories with digital technologies, present an e-portfolio of work or a single presentation, and so much more.

Adding to the core program, since its public launch in May 2007, the Scratch website has become a vibrant online community, with people sharing, discussing, and remixing one another's projects (Resnick, 2009). Each day, Scratchers from around the world upload more than 11,500 new projects to the website. The collection of projects is now wildly diverse, including video games, interactive newsletters, science project simulations, virtual tours, birthday cards, animated dance contests, interactive tutorials, and more (Resnick, 2009).

By using Scratch, students become familiar with basic computer science skills, mathematical concepts, and problem-solving techniques, while enabling and encouraging them to think creatively. Scratch helps students personalize the development of what they want out of their ideas. Using their imagination to play with their creations, sharing ideas and invention with others, leads them to imagine new ideas and projects (Resnick, 2007b) as they complete the task at hand.

In Scratch, programming does not necessarily mean writing program code. Scratchers select and manipulate the program blocks, which already contain constructed coding to perform pre-defined tasks. This enables users to create scripts that, in turn, command objects or characters on the screen. Scratch is designed to be an extremely interactive form of expression. Students click on a stack of blocks, and it starts to execute its code immediately (Resnick, 2009). Students can adjust the stack of blocks based upon a plan and expected action, making it easy to experiment with new ideas incrementally and iteratively.

Resnick (2009, 2007b) stated that digital fluency requires not just the ability to chat, browse, and interact, but also the ability to design, create, and invent with digital media. The ability to program expands the range of what you think and learn, while providing the opportunities to learn important problem-solving and design strategies.

Many educational software designers and commercial companies have attempted to capitalize on goals related to the energizing of behavior by making programs for learning. Some forms of software have stressed excitement as a way to motivate students' desire to interact with the program and then learn—consciously or subconsciously. Papert (1980), in his book, *Mindstorms,* emphasized that it is mandatory to rethink the approaches to education and learning in a way that enhances students' competence, quality, and excellence within the digital environment. While using Scratch, students begin to create reports and presentations, replacing traditional PowerPoint or written papers with content that is far more dynamic and interactive. In that dynamic environment is found excitement for learning. Scratch is then one set of learning modalities I used to analyze the implementation of digital media within learning strategies.

Research Questions

This study is built upon four major questions to attain the study's goals:

1. What are the teachers' intentions for teaching digital media?
2. What happens in the classes through the use of digital media?
3. How does the use of digital media affect students' educational experience?
4. What are the implications for education in general?

What Are Teachers' Intentions for Teaching Digital Media?

Technology-driven venues for teaching and learning are springing up everywhere, and technological innovations are having unanticipated influence on the form and results of schooling. Students have come to view technology as just another part of their environment, and they have absorbed it, along with everything else (Tapscott, 2009). In this changed context, the teacher can no longer be simply a lecturer or instructor—someone who passes on knowledge and advice about "how to do it." Today's students need a different form of education from the ways they have learned before. Schooling is much more than the mere transfer of knowledge. Students also have to connect the information to what they already know, develop mental models, and learn how to apply the new knowledge and adapt it to new and unfamiliar situations (Tapscott, 2009). Teachers who address digital media curriculum as a pivotal concern for assisting this new generation of students hold a perspective that is contrasting with their earlier tools and techniques.

Miller (2008) commented that intention in teaching begins with a strong set of beliefs. Teachers hold an important role in classroom practice, such as their use of tools, planning of the curriculum, and integration of modern techniques. In an environment of digital media, teaching, and learning, teachers are expected to add this new vocabulary to their work and enrich the study experience within the contemporary age. This was fundamental to my research, wherein I reviewed the intent of educators as it was modified and expanded through the use of digital media.

What Happens in the Classes Through the Use of Digital Media?

Jenkins, Clinton, Purushotma, Robison and Weigel (2009) emphasized that educators must work together to ensure that all young students have access to the skills and experiences needed to become full participants in the learning process and can articulate their understanding of how media shapes perceptions. We, as educators, need to know how these experiences are socialized into the emerging convention that shapes students' practices as media makers and observers/consumers. My intent in this study was to discover how digital media curriculum enhances students' participation in the classroom-learning environment. Further, I scrutinized the ways students use media and explored how that energy might be best used to help motivate them academically.

How Does the Use of Digital Media Affect Students' Educational Experience?

According to a recent study from the Pew Internet & American Life Project, more than one-half of all teens that create media content and roughly one-third of teens that use the Internet share what they produce (Jenkins et al., 2009). Students are on the computer almost constantly, and digital media motivates them to learn independently (Johnson, 2009). Resnick (2009), Professor of Learning Research at MIT Media Laboratory, raised a concern: As these new technologies have the potential to fundamentally transform how and what people learn throughout their lives and new digital technologies make possible a "learning revolution" in education, what is the form of that transformation? Many have opined that where the activity is participatory, it represents valuable tools or skills in the digital era. But a growing number of educators and psychologists have expressed concern that computers are stifling students' learning and creativity, engaging students to undertake mindless interaction and passive consumption (Cordes & Miller, 2000;

Oppenheimer 2003; Resnick, 2006). And still other factions consider computer technology to be used solely for checking e-mail, typing papers, or browsing on various websites, and so on. This study presented not only how students interact with digital media technologies but also opportunities to broaden students' multifaceted thinking and creativity.

What Are the Implications for Education in General?

Teachers might do more things faster and differently with digital media, but teachers may also be using new technologies in old-fashioned ways, much the same as they did before (Delacruz, 2009; Roland, 2007). Some educators have recognized that technology introduces new-world thinking (Trilling & Fadel, 2009), and there is a way to make learning feel simultaneously more relevant to students and more connected to the world beyond schools (Corbett, 2010).

Corbett (2010), in the *New York Times* article, "Learning by Playing: Video Games in the Classroom," stated that the technology that fuels our world has become the source and organizing principle of our children's learning. Educators should integrate this digital media and technology into students' learning rather than separate it from their learning as one specific subject. For example, the non-profit organization, Quest to Learn, organizes its curriculum specifically around the idea that digital media games are central to the lives of today's children and, as their speed and capability grow, increasingly powerful tools for intellectual development (Cashiola, 2010). Katie Salen, a professor of design and technology at Parsons the New School for Design, and her colleagues are wrapped up in the idea that technology is doing for learning what it has done for almost every other aspect of living (Corbett, 2010). As anyone who has ever checked e-mail from a bathroom or chatted Twitter from a chairlift can attest, what once occurred in just one space now happens in practically every space. I have posited that digital media is part of the life of today's generation of students. According to Levine, kids are literally wearing digital media; it is present everywhere in their lives, except in the learning environment (Corbett, 2010) in an organized and consistent form.

This study explored the thought process and work of teachers who embrace digital media integration and how this integration impacted students' understanding. As a result, I discussed the implications of these findings not only for the use of digital media integration in regular education, but also for teachers who are interested in forms of integration with digital media for the future.

Conclusion

According to Palfrey and Gasser (2008), I am classified amongst the "Digital Immigrants," which describes people who have adopted technology later in life and learned to adapt it to their environment. I was familiar with the old-fashioned library card and VHS tape, and recently I found ways to live, learn, and communicate with my iPad. Whereas the Digital Native may learn *with* technology, I appreciate the actual creation of media technologies and enjoy learning *through* the act of creation. But it would be foolish to jump to conclusions about the future of education based solely on the age of a learner. There are still concerns over the role of media technology in younger students' lives as they encounter new ways of teaching and learning. Much research has been done on how students learn with computer technology, how digital games enhance learning, the impact of educators and parents' attitudes, how students choose media experiences, and more. There is no doubt that educators as well as parents have to become conscious about students' learning in a digital world. It was expected that my research would show that digital media is not a defining feature of our students' lives, but it is a part of their life and how they grew up. They are curious and ready to explore and experiment with what they already know. Indeed, students compose new ways of engaging with technology that expand their existing understanding.

CHAPTER TWO:

LITERATURE REVIEW

In this chapter, I discuss a variety of definitions and exhibit several themes on educational responses to digital media in the digital era. I then present several aspects of teachers and students' attitudes as they approach the digital media environment for teaching and learning. Overall, this is an overview of the current circumstance and a reflection on why advancing toward digital media curriculum may provide a significant pathway to 21st century schools.

Introduction

Whereas most people consider "digital media" an uncommon event (Latour, 1991), newer technologies, or a cyber-culture (Levy, 1997), we engage daily with digital media, both consciously and subconsciously, viewing it as part of everyday life. Pavlik (2008) defined digital media as the systems of public communication, the systems of content production and distribution, and the computers and networked-based technologies that support and shape them. This study proposed that the very presence of digital media represents a reintroduction of digital-age understanding that is fostered by the development of technological creation, everyone's individual initiative participation. When digital media become an everyday occurrence, the construction of a learning experience becomes a common language, and our attention to digital technologies becomes more naturally integrated into daily life. Digital media technology reflects a general day-to-day experience.

It has been said that new media bring a new perspective to the 21st century (CBS News, 2009); however this does not present the goal or the ideas behind creating in life (Werner, 2007). New media prompt us to learn to live in the world today and be prepared for tomorrow. This change in our lives and thinking to new digital media spawns a new mode of experience and style of discourse, as technology interfaces with pedagogical methodology (Tillander, 2008). Digital technologies are ubiquitous in life today. This is a digital era dominated by technology. The key is searching for methods to inspire critical thinking and become an even more creative individual. Educators need to hold the view that education not only transfers knowledge to our students, but also leads them to perceive their strength as individuals, through the use of critical thinking derived from creative presentation and problem solving. Further, educators have a responsibility to inspire the young to be independent and discover their full potential, so they can realize how acquiring the use of technology adds to and improves all facets of their life in the digital era.

When McLuhan (1964) stated, "Medium is the message" (p. 107), his premise was that all technologies are extensions of human capacities (Murphie & Potts, 2003). Digital media are not tools to be used in different ways, but are part of our environment, becoming invisible, yet influencing and shaping us in highly significant ways. When we are excited about the new creation of the iPod, iPhone, iPad, and so on, these and other digital technologies have emerged omnipresent in our daily life. Children now grow up with these devices and operate them without any problem, seeing them as seamlessly integrated into their lives. Although we have no clue about the *when, where*, and *what* of the next new creation, the changes and advances in technology have taken our communication and interpretation to a new form of language by opening up exciting and unlimited creative experimental opportunities.

The Changing World: Re-Thinking the Approach of Digital Media in the 21st Century

Virtually everyone today is reasonably proficient in interacting globally via text, verbal, or video communication. You can read comments about products and compare prices before you purchase your Christmas gifts. You can even plan a trip, reserve your hotel, and book your airfare while you retrieve maps for your holiday vacation. While you are abroad, you can share your travel notes, photos, and videos through mobile devices and the Internet, doing all of this in real time—live broadcasting and interacting with the world.

Try to picture the same situation 25 years ago, and you cannot (Kressel & Lento, 2007). There is no doubt from digital media technology to the Internet, from Google to global positioning systems[7] (GPS) and the mobile phone, the feeling of novelty and ingenuity embodied in these technologies, many of which are experienced daily by millions of individuals around the world, is having new and not yet fully understood

[7]A space-based global navigation satellite system (GNSS) that provides location and time information in all weather and at all times and anywhere on or near the Earth, when and where there is an unobstructed line of sight to four or more GPS satellites.

impacts on our everyday life experience. Digital technology is changing everything in our lives, remaking society on its own (Fisher, 2010). The combination of the wide availability of portable personal devices, the Internet's interactivity, and high-speed access is making the user not only a passive consumer but also a producer, participating with and changing the very essence of today's digital society.

Since the invention of the computer little more than 50 years ago, technology has made tremendous progress. But we did not witness the true rise of computers as part of the field of new digital information and communications technology until the mid-1990s (Fischer, 2006). In the first decade of the 21st century, computer-based devices for accessing and displaying media content became widely available in the United States and around the world (Pavlik, 2008). As a result, the area of technical innovation has so drastically altered the way we live, work, and interact in such a very short time (Kressel & Lento, 2007) that the subsequent influences on life, learning, and our actual thought processes are not yet fully understood. These influences have become a focal point of today's educational and sociological researchers. Moreover, when we recognize that digital electronics give us instant access to a whole universe of information and provide us with powerful usages to process this information, we need to recognize the omnipresence of the Internet in everyday life (Fuchs, 2008).

In 1991, the first commercial use of the Internet was permitted, and the appearance of the rudimentary Mosaic browser in 1993 made the web user-friendlier. In fact, the number of web servers jumped from 50 to 10,000 in a single year (Fischer, 2006). The Internet has established itself with remarkable, perhaps unprecedented, speed as an integral part of everyday life for many people all over the world, at work and in the home (Kung, Picard, & Towse, 2008a, p. 1). The Internet is a unique technology in its varied components and wide range of uses. It is interactive, enabling point-to-point communication through e-mail, chat rooms, and instant messaging, but also supports broadcast capability through text, video, and visual images, directly "user to user" on web sites (DiMaggio, Hargittai, Neuman, & Robinson, 2001; Mossberger, Tolbert, & McNeal, 2008; Wellman, 2001). In some instances, the Internet supplements problem solving via existing technical solutions (Henten & Tadayoni, 2008) and provides a new model for society. Therefore, the convergence of digital technologies and the Internet brings computers, telecommunications, radio, and television closer together. Moreover, it gives rise to countless applications in practically every sphere of human activity for numerous technological and commercial innovations, and brings these major markets closer together (Fischer, 2006). Overall, the Internet presents a remarkable new electronic system, with extraordinary advances in communications, and embodies transformational power (Kressel & Lento, 2007).

According to Kung et al. (2008a), the word "Internet" represents a catchall phrase for a number of technological developments that relate to economic and social changes. In recent years, information has been increasingly converted into digital formats, from consumer entertainment products to corporate knowledge. Once information has been digitized, several possibilities for new products and services may become evident. As recalled from above, on the Internet, we can search for information, plan trips, read newspapers and articles, and communicate with others by making use of e-mail, instant message, chat rooms, Internet phone, discussion boards, mailing lists, and video conferencing. We listen to music and new forms of radio, watch videos, order or purchase goods, write blogs[8], and contribute to the blogs of others; we meet others, become friends, fall in love, or develop intimate relationships; we initiate and maintain contact with others. We protest; learn; play games; create knowledge together with others; share ideas, images, and video-downloading, uploading, communicating; and much more (Fuchs, 2008). The rapid growth in Internet use means that the Internet and digital technologies have become part of daily life for an increasing number of people (Mossberger et al., 2008).

We can think of the Internet, including the World Wide Web, as the pivotal contribution of electronic technology to the dissemination of information in today's world. The Internet is a global techno-social system that is a decentralized technological structure consisting of networked computers that store objectified human knowledge (Fuchs, 2008); it increases the availability and accessibility of all types of information. Several scholars see the Internet as digitalization, the true enabler of convergence (Kung et al., 2008a). *Convergence* is understood as the technologically driven fusing of the content (media), computing (information technology), and communications (telecoms and broadcast distribution) industries (Bradley & Nolan, 1998; Chakravarthy, 1997; Kung et al., 2008b). However, Watzman (as referred to in Pavlik, 2008) emphasized that rather than focus on convergence, we should be focusing on connections and how new digital technologies can help us build all kinds of new connections with our audiences. Such connections define the potential of digital media as "not simply more noise but

---

[8]Blog is a type of website or part of a website that allowing visitors to leave comments and messages. Blog is usually maintained by an individual with regular entries of commentary, descriptions of events, or other material, such as graphics or video.

more meaningful interaction and…more meaningful learning" (as cited in Pavlik, 2008, p. 76).

Whereas most people recognize the Internet and digital media as technological concepts, Fuchs (2008) considered the term *information and communication technologies* (ICTs) more suitable. Information is the true driver of interpersonal interactions, civic engagement, business operations, political discourse, and every other physical and virtual interaction in an age defined by the omnipresence of ICTs (Jaeger & Burnett, 2010). The Internet is seen not only as one specific network but also as the general phenomenon of the interconnection of networked knowledge-based technology (Fuchs, 2008).

Marshall McLuhan is quoted as saying, "The Internet has been an extension of man" (as cited in Bakker & Sadaba, 2008, p. 86)**.** Digital technology and the advances in and on the Internet foster new relationships between content producers and users (Pavlik, 2008). According to Internet World Stats (2010), the number of Internet users worldwide reached nearly two billion as of June 2010. Correspondingly, users who have been empowered by digital technologies not only substantially modify their work for this delivery mechanism or "information-getting" routines, but they also affect the way people around the world interact with media, content, and other users (Bakker & Sadaba, 2008). It is as if we see content producers consciously having changed their message to suit the format of the Internet and how people use it.

Interactivity itself becomes the medium connected to the users and brings potential for improving more efficient use of resources. For example, it may literally eliminate the library and the whole process of using a physical resource. In turn, the varied forms of Internet delivery make virtually all its content more engaging. Jensen

(1998) defined *interactivity* as “a measure of a media’s potential ability to let the user exert an influence on the content and/or form of the mediated communication” (p. 201). This is a very valid definition, but even more, we see that nonstop interactivity is now one of the most significant shifts ever in the human environment (Ritchtel, 2010); it extends humans’ ability to influence the content of everything they see, hear, and experience. Accordingly, this influence may mandate a new or, at least, broader and more comprehensive definition.

One way to understand the different ways groups interact is via collective intelligence, the concept the French social theorist, Pierre Levy, first introduced in 1994. *Collective intelligence* refers to “open-minded, cognitive subjects capable of initiative, imagination, and rapid response [involved in] innovation networks” (Levy, 1997, p. 1). Collective intelligence has been applied to the new ways knowledge is being constructed through social media (Beetham & Oliver, 2010). Technological developments, such as distributed computing, online interactions across space, and rapid communications themselves, have created enhanced capabilities for problem solving in a wide variety of fields of study, entertainment, and communication. Currently, the model of collective intelligence has been developed as a deliberative body of works via distributed knowledge and network forms. Some of the examples can be seen as crowd sourcing, file sharing, management theory, feedback, and interactive marketing—all in the context of information and Internet content delivery. We also have to understand the ontology of the network itself: how networks individuate or are individuated via the political and philosophical task.

Various expressions and terminology or a new lexis has recently been adopted to describe the meaning and passion of this 21st century concept of "network." Castells (1996), in his book, *The Rise of the Network Society,* stated that the network society is concerned more about how networks operate as distributive apparatuses of "information" than with the legacy of broadcasting and its role in producing and distributing entertainment. Because a widespread reliance on digital media has evolved, the Internet and World Wide Web are now pervasive in contemporary life and are purported to be so thorough as to warrant the expression "network society." Deuze (2007), in his book, *Media Work*, applied Castells's rationale about the network society to map the new centers and geography of "creative industry," while emphasizing how digital media play an increasingly central role in the modern life and productivity (work and play) of consumers.

Deuze (2007) echoed the rationale advanced by Henry Jenkins in proposing that the human condition of the network society is itself a convergence. This is more pronounced when seen through the lens of those at the forefront of those changes. Deuze attributed the current media convergence primarily to an economic logic, specifically driving the production, distribution, and commercial synergy of multiple media. He argued that this logic is worth mapping, because these media networks and technologies have become central to contemporary life, although he examines the networks of interactive consumers and media life mostly in terms of their value within the new geography of creative industries. Jenkins's (2006a) argument about a new "convergence" culture most energetically addresses the tension (or arrangement) between media industries' strategies for encouraging consumers' (particularly the most active participants, gamers, and fans) participation, active involvement, and interactivity with the production and with life. For example, he puts forth the notion that in gaming, the user has a rising level of influence on the games themselves and is less and less a mere player.

The network user is part of this evolution. Users are involved, because the medium requires that they not be mere viewers; rather, their active role is essential to the very function of the network. The point here is to look at the use of the Internet and digital technologies, the impact these technologies have, and how they affect the way in which people study, work, and look for information or communicate with others. Everyday experiences in the network and the very use of the network itself shape what we understand of life. The network then shapes life and all its elements, including learning via a direct form of education or by experience. Without the Internet, the iPad or other digital devices would probably not be around (Bakker & Sadaba, 2008), because their need is largely derived from an ever-increasing demand for Internet access everywhere and all the time.

How We Receive the Information

Since the invention of paper in 105 AD and Johannes Gutenberg's refining of the printing press in 1448, books and newspapers have always played an important role in delivering information to readers (Landa, 2006). But with the dawn of the "information age," one must consider the increasing use of the e-Book format. It provides readers with books or articles on digital devices and vastly expands the readers' choice and sense of immediacy. Most traditional publishers, whether of newspapers, magazines, or books, have adapted their own print products for online distribution and consumption (Pavlik, 2008).

With the advent of Google, everyone can broadcast and research information across the intellectual universe (Pavlik, 2008). The services of Google Scholar[9], Google Docs[10], and Google Map[11] have provided many people with lives that are simultaneously more convenient, while allowing for the ability to amass great quantities of unfiltered information without much difficulty. Phenomena, such as blogs and wikis, have clearly become significant parts of the current overall information life-world, enhancing the ability of individuals and specific, narrowly focused, small communities to access information and become information providers themselves, without requiring them to adapt themselves to the controls and rigors of traditional publication media (Jaeger & Burnett, 2010). One of the most popular websites, Yahoo, contains a bewildering combination of information: There are links to "news," business, sports, and celebrities, and stories of popular culture. The web portals, such as Google and Yahoo, serve as gateways for millions of people around the world, and to any one of billions of web pages of varying topics, sources, genres, and points of view (Press & Williams, 2010). Yahoo has expanded its video content with ABC News, which increases the amount of visible

---

[9]Google Scholar is a website that provides a search of scholarly literature across many disciplines and sources, including books, abstracts, articles, and so on ("About Google Scholar," 2011).

[10]Google Docs creates and shares your work online and accesses your documents from anywhere (Google Docs, 2012).

[11]Google Maps helps to find local businesses, view maps, and get driving directions. Also, it allows you to explore places around the world through satellite (Google Maps, 2012).

content (*Daily News*, 2006), yet again taking a page from older forms of media delivery, such as television. Viewers now have more choices to watch or experience the news on personal devices instead of watching TV or reading the newspaper. Since November 2009, the Taiwanese newspaper, *Apple Daily,* has provided the Apple Action News service to deliver dynamic news. Simply put, it is Apple Daily video news. Users who access Apple Daily video news can instantly view a video or animation of news on their website. Or they can input the code to their mobile phone, which Apple Daily provides in the newspaper, and increase their accessibilities and timely access to these data. They can then watch their choice of videos or animation news directly by phone (Jeremy, 2009). In his book, *Digitizing the News*, Boczkowski (2005), a MIT professor, contended that news in the online environment is what those contributions to its production make of it; the medium is again an integral part of the message. News is moving "from being mostly journalist-centered, communicated as a monologue, and primarily local, to also being increasingly audience-centered, part of multiple conversations, and micro-local" (Pavlik, 2008, p. 73). Here again, the changing nature of information value may be tied to how heavily many people rely on the Internet for information and all forms of interaction, and how easy it is to use (Jaeger & Burnett, 2010). In fact, digital news itself is nothing special in the 21st century. But, if you look closely at the strategy of this innovation, you will find digital media integration has spread without any effort in modern society. It is as if society itself anticipated these changes or consumer habits have changed and now demand them.

When McLuhan (1964) commented that changes in broader communication cultures alter the very structure of human consciousness, I suspect he would readily have understood how easily we have embraced these changes. Already, the emergence of the Internet and digital technologies has changed the way we access information. For example, 5 years ago, when the MP3 format for music had only just become established, it was predicted that electronic books would displace paper book sales (Kung et al., 2008a). The Internet offers unbundled content items (articles, songs, video files, etc.), and the Hyperlink enables us to combine these elements as we see fit into our own individual content experiences (Wurff, 2008). We can read a book on a personal computer, Kindle Book, or even a mobile device. Media in the digital age has become ever-present, interactive, mobile and portable, wireless, on demand, modality rich, and instantaneous.

How We Communicate

When we think about the digital media environment, including the Internet, cable and satellite television, digital video recordings, MP3 players, Kindles, mobile phones, and more, it is easy to get caught up in the sense of wonder we feel as each new technology is placed in our hands (Press & Williams, 2010). Moreover, we discover new ways of use and forms of inquiry that may very well be or become our primary source of communication with the broader world.

Traditionally, social interaction in the local community was the basis for communication—face to face. Yet today, face-to-face meetings are no longer the primary way to communicate (Kaur, 2010). There are numerous ways in which people have changed the way they communicate over the last 50 years. E-mail (electronic mail) probably is the most common communication tool people use daily (“E-mail,” 2010). Whittaker and Sidner (1996) stated that e-mail is one of the most successful computer applications, with millions of users worldwide who often spend significant proportions of their work time using it. Research has suggested that e-mail has contributed to the growth and distribution of organizations by allowing people in different geographical areas to communicate across time and space (Kaur, 2010). It has also led to the emergence of on-line communities by supporting asynchronous communication (Sproull & Kiesler, 1991; Whittaker & Sidner, 1996) that is no longer constrained by time or space.

In addition to e-mail, consider the use of Skype[12] and MSN Messenger[13], as well as other voice messaging programs, which are available for free use to anyone in the world who visits the website, installs the software, and registers with it through Internet access (Pavlik, 2008). In this way, you can have a voice communication anywhere in the world. These programs can expand discussion beyond the classrooms, schools, workplaces, countries, regions, and so forth, and provide new ways to collaborate and communicate around the world (Bryant, 2006).

Over the years, the telephone has dramatically changed how people live their lives and engage with their world (Katz & Aakhus, 2002). But now, the device we call the mobile phone is changing to include not only speech but also a novel array of digital media-supported communication and social interaction. Today, the mobile phone has moved beyond a mere technical device to becoming a key "social object," present in every aspect of our daily life (Srivastava, 2006). With web access, mobile phone technology affects the way we interact with the surroundings and enlarges the radius of conversation. The use of mobile phones speeds the pace and efficiency of life and also

[12]Skype is a software downloaded on the Internet for communication through text, voice, and video, making it easy on the digital devices.

[13]Windows Live Messenger (formerly named MSN Messenger) is an instant-messaging tool created by Microsoft.

allows more flexibility for business and professional levels as well as personal life (Katz & Aakhus, 2002). Mobile phone applications are continuously developed and increasingly structure the users' experience and behavior (Zach, Gretzel, & Xiang, 2010). The unprecedented rise in the number of mobile phone users has a number of consequences and implications, but perhaps the most significant impact is on access, both to basic telecommunication services and to other information and communication technologies as tools for economic and social development (Srivastava, 2006). The "movable" and "portable" quality of the mobile phone is of course its key function. However, we are aware of the spread of mobile phone use and with it, the establishment of a new form of communication behavior, for example, consumer-to-consumer interaction, mobile social networking, texting, chatting, and dating (Sirasoontorn, 2009). The ubiquity of the mobile phone means that the distinction between the public and private spheres of human existence has become blurred because of this new form of communication (Srivastava, 2006).

Texting through the mobile phone has become a popular form of non-verbal conversation in society. *Text messaging* or *texting* refers to the exchange of brief written messages between mobile phones and fixed or portable devices over a network (Srivastava, 2006). In the United States, as reported by CTIA in December 2009, the 286 million U.S. subscribers sent 152.7 billion text messages per month, for an average of 534 messages per subscriber per month (CTIA, 2010). The Pew Research Center found in May 2010 that 72% of U.S. adult mobile phone users sent and received text messages (Pew Internet & American Life Project, 2010). Text messaging has become so popular that advertising agencies and advertisers are now jumping into the text messaging business. Services that provide bulk text message sending are also becoming a popular way for clubs, associations, and advertisers to quickly reach a group of opt-in subscribers (Mennecke & Strader, 2003).

Access with Web 2.0[14] offers users the expanded ability to interact or collaborate with each other via a social media dialogue as consumers of user-generated content in a virtual community, in contrast to websites where users are limited to the viewing of content that was created and controlled by others (Sharma, 2010). Some examples of Web 2.0 include social networking sites (e.g., MySpace and Facebook), wikis, blogs, video-sharing sites, hosted services, and web applications. Web 2.0 allows users to do more than just retrieve information: It provides users with more user-interfaces, software, and storage facilities, all through their browser (O'Reilly, 2005), and further demonstrates the dynamic and interactive nature of these media.

According to 2010 statistics, there were over 500 million active users on Facebook, 50% of which log on to Facebook on any given day, and people spend over 700 million minutes per month on Facebook (Facebook, 2010). These users are learning to depend on Facebook for both their social knowledge as well as extended representation of their own identity and other personalities (Ginger, 2008) of their own choosing.

This is a phenomenon of cyberculture (Levy, 2001) and the networks they create. The concept of *cyberspace* attempts to identify and examine the consequences for the creation and re-creation of communities and communication in virtual spaces (Aleman & Wartman, 2009). Ginger (2008) suggested that the technological-social network is

[14]The term, Web 2.0, is associated with web applications that facilitate participatory information sharing, interoperability, user-centered design, and collaboration on the World Wide Web (Web 2.0, 2011).

comparable to a 21st century organism. It is dynamic in the content provided; the providers are, themselves, living and evolving people; and the very technology and format of delivery is alive with change.

We often think of communication as the exchange of words or information between people, but there is also a broader set of actions we take that can modify the act of communication. Thinking of digital technologies more specifically, from their use and influence upon every facet of our lives, we might come across real and fundamental changes in the way we live. Regarding all these technologies, Mossberger et al. (2008) remarked that what they represent is a form of digital citizenship. The Internet and digital technology highly impact and benefit how we retrieve information, communicate with others, and participate in the digital age. Kay (1990) said that the alien and foreign nature of these technologies applies only to people who were born before they were invented. Nevertheless, regardless of a person's age, digital technology is dramatically affecting the future and is itself a part of life today. Communication and information are basic agents of social change and development, and it is essential that countries and regions are able to fully participate in the global media and communication system (Pavlik, 2008). Although we discuss preparation for our I-Generation, Digital Native, and so on, we already participate in these networks every day and so does today's youth, with access to these technologies. When the idea of goods as emergent qualities of human cooperation is reflected in definitions of social software and the web that focus on the qualities of collaboration and collective intelligence (Fuchs, 2008; Kolbitsch & Maurer, 2006; O'Reilly, 2005; Tapscott & Williams, 2006), we will see a new evolution of human thought.

Today's users are co-evolving with digital media. They are learning to access and create content in a non-linear fashion. They are developing new habits of reading and thinking, which are not the leftover habits from print media. As the tools change the users, the users change the tools or create new ones. As users become fluent with the screen as a non-linear information environment, they adapt these environments and their interaction with them directly to their process of thought. Ultimately, digital media springs off in various directions. Our primary aim of exploration of digital media should not be directed towards content; rather, it should focus on digital media as a method for observing what we ourselves experience in everyday life, education, and connection to the world. Digital media technology is inseparable from life, and the aim of today's educators must become the agent of integrating its use into today's curriculum.

Contemplating Education in the Age of Digital Technology

Tapscott (2009) claimed that kids have come to view technology as just another part of their environment, and they have absorbed it, along with everything else they see, hear, and experience today. A core concept of growing up today is that this is the most rapid period of technological transformation seen thus far (Palfrey & Gasser, 2008) in human history and evolution. Prensky (2001) described these students as growing up with digital technology and speaking its language. Students growing up with digital technology are curious and ready to both apply what they already know and explore new questions, answers, and ways to ask and solve. They incorporate new ways of engaging with digital technology that modify their existing understanding in a continuous spiral of making sense of the world around them, while increasing their competence in all facets of their lives (Plowman, Stephen, & McPake, 2010).

Developing students' competence with technologies extends beyond the operational aspects of how to use technology to include understanding its role in work and play. Rosen (2010a) asserted that students rely on technology for many aspects of their lives. Educators need to find ways to match their teaching with the students' lifestyle. What I have addressed in this study is an empirical describing of some of the forms of learning *with* technology instead of learning *about* technology. This includes taking into consideration how learning with technology takes in the social and digital technological landscapes in which students spend time.

Whereas William Gibson was quoted as saying, "The future is already here, it is just unevenly distributed" (as cited in Bilton, 2010, p. 8), I agree with Collins and Halverson (2009) that technology-driven venues for learning are springing up everywhere, and technological innovations are having unanticipated influence inside and outside of the public school system. Tapscott (2009) stated, "For the first time in history students are more comfortable, knowledgeable and literate than their parents about an innovation central to society….They are a force for social transformation" (p. 368). New technologies may afford new ways of thinking, creating, connecting, and collaborating, thus allowing students to direct their own learning, have more agency, and be more engaged in their education (Cullinane & Hess, 2010).

Undoubtedly, digitally-enabled participatory learning has already transformed how we learn and, in many ways, what we learn, and has impacted institutions of learning (Davidson, Goldberg, & Jones, 2010). Learning is shifting from a structure of authoritativeness to distinguishing good knowledge sources and substance from those that are questionable. Davidson et al. (2010) argued that learning is increasingly about how to make wise choices epistemologically and methodologically. This utilizes productive collaborative partnerships to broach complex challenges and problems.

Learning can happen in any situation that young students encounter. Learning is not a one-way process: Students do not merely absorb what others demonstrate to them; they also expand their learning as they actively contribute to society's understanding and knowledge (Plowman et al., 2010) as well as forms of inquiry. Indeed, learning as practice is unseen but made evident by changes in students' level of skill, confidence, or knowledge. Effective support for learning involves recognizing the kind of opportunities the learner needs next, arranging the environment to offer these opportunities in an engaging and positive way, and supplying the right mix of resources (Plowman et al., 2010). Focusing on new learning with digital media means that rather than schools and teachers seeing their task as handing out a set of skills and knowledge that can be readily assessed, their role should be reconceptualized as ways of communicating, thinking, and working with others. New digital technologies are central to this concept of new learning, and "young students are capable of understanding, making sense of and communicating concepts and ideas in multimodal ways and…can frequently incorporate the effective use of digital technologies to strengthen and amplify their learning" (Plowman et al., 2010, p. 39). Technology gives us enhanced capabilities for educating learners, and schools should embrace these capabilities to reshape education (Collins and Halverson, 2009). The MacArthur study summary (Rosen, 2001a) trumpeted the enormous educational value and potential of social networks:

> To stay relevant in the 21st century, education institutions need to keep pace with the rapid changes introduced by digital media and youth's participation in this networked world suggests new ways of thinking about

> the role of education. What would it mean to really exploit the potential of the learning opportunities available through online resources and networks? (Rosen, 2010a, p. 39)

Technology can support and mediate learning, just as adults and peers can, and the technologies encountered will afford or prompt learning in different modes (Plowman et al., 2010). The increase of digital technologies enables and encourages students' collaborative engagement, implicating, impacting, as well as interacting on learning and social networking. Digital technology can alter learning relationships more than traditional resources and provides previously unimaginable opportunities to deploy artifacts, which can then be used as the basis for activities for students to engage in (Harding & Ingraham, 2007). Corsaro (1997) argued that students do not just adopt and internalize what is given, but reinvent and reproduce as they "negotiate, share, and create culture with adults and each other" (p. 17). Technology offers many young students opportunities for and examples of this process of cultural production. In their awareness of a whole range of digital devices, students make technology work for them or use props to stand in for technology to which they do not have direct access. It is the educators' responsibility to help them make sense of these new contexts and meanings (Palfrey & Gasser, 2008). Traditional learning institutions, both K-12 and institutions of higher learning, continue to prioritize individualized performance not only in assessments and reward structures using a test, but also in the measuring of mentality. After a century and a half of institutional shaping, maturing, and hardening, these assessment and reward structures have become fixed in place. They now serve to weigh down and impede new possibilities in learning (Davidson et al., 2010).

Education should excite and stimulate students, and will, if educators make radical changes in our conceptualization of teaching and learning. Then, students would be learning through the context of technology as it helps them better realize their passion (Collins & Halverson, 2009). Many educators have made predictions as to how the processes of teaching and learning could be transformed by the new age with digital technologies (Collins & Halverson, 2009). Even those educators who do not embrace technology in their lives must understand the *possibilities* of the new technologies from the inside, while they guide the future of education (Collins & Halverson, 2009). Students are ready and willing to be the future (Rosen, 2010a). This is a generation that learns differently, and unless educators recognize and accept those differences, they will turn the students off education.

Technology is the key driving force of change in the world today. While educators discuss education reform, they should fully consider utilizing digital media technology to both prepare these young students for the world today and permit them to be inspired creators of the world tomorrow.

Mobile Learning

A 2009 national report from the Joan Ganz Cooney Center, presented at the workshop, *Pockets of Potential: Using Mobile Technologies to Promote Children's Learning,* outlined that the mobile device is the most ubiquitous technology (Srivastava, 2006) in students' lives today. Many devices are described, such as the mobile phone, iPod, iPad, and portable gaming platforms, that help students, even in low-income communities, improve 21st century social interactions and personalized learning experiences (Shuler, 2009). Research has convincingly shown that students thrive when curricula incorporate mobile learning devices, such as PDAs[15] (personal digital assistants), iPods, iPads, and mobile phones. For example, a 5-year study at the Research Center for Educational Technology at Kent State University found that using handheld devices in the classroom improves student motivation, increases feelings of engagement, improves student motivation, and enhances problem-solving skills (Rosen, 2010a).

Mobile learning should be the key to the future of education. Rosen (2010a) brought up Professor Elliot Soloway of the University of Michigan's comment in *Pockets of Potential* (a 2009 national report from the Joan Ganz Cooney Center Workshop):

> The kids these days are not digital kids. The digital kids were in the '90s. The kids today are mobile, and there's a difference. Digital is the old way of thinking, and mobile is the new way. As usual, adults have not yet caught up to the kids. The bulk of public sentiment surrounding mobile devices and learning today is largely unenthusiastic, with many educators and parents concerned that they can cause distraction and other harmful behaviors. But the social and cultural phenomena, the market opportunity, and most important, the "pockets of educational potential" documented in this report should not be dismissed. The debate in the coming decade should no longer be whether we should use devices to support learning, but about exploring how best they can be used. Just as Sesame Street introduced children and their families to the potential of television as an educational medium two generations ago, today's children will benefit if mobile becomes a force for learning and discovery. (p. 203)

Social Networking

Teens spend a great deal of their time on Facebook, My Space, Second Life[16], and other social networks. Whereas some educators and parents are fearful of the influences

---

[15] A personal digital assistant (PDA), also known as a palmtop computer or personal data assistant, is a mobile device that functions as a personal information manager. Current PDAs can access the Internet, intranets, or extranets via Wireless Wide Area Networks. Many PDAs employ touch screen technology (Viken, 2009).

[16] Second Life is a free 3D virtual world where users can socialize, connect, and create, using free voice and text chat (Second Life, n.d.).

that digital technologies are having on their students and their ability to learn, it should be noted that teens use their social networks as platforms for creating vast amounts of “content” (Rosen, 2010a). They write bountifully, post self-made videos and artwork, and in actuality, invest vast portions of their online time being creative. I agree with Rosen (2010b) that social networks have become platforms for teens to develop material that engages all of the senses and thus has strong learning potential. In addition, many teens consider social networking sites as their primary social world. All of their friends are there, as if it were a physical place, and their friends respond with feedback and amplification, responding to and showing genuine care for their posts as fast as they can, as if it were a real conversation. These social networking sites offer a variety of modalities, which provide nearly unlimited access to information sources and support cooperative learning. Students share their concerns with friends and make all manner of comments in this collaborative environment. Rosen (2010a) also said that if educators can set aside their media-driven prejudices against social networks, these networks can become fantastic vehicles for providing curriculum materials, both within the classroom and while students are at home. This is an excellent opportunity to assist students’ bringing their real world into the classroom.

Students born at the start of the 21st century are growing up in a world in which digital technologies are not only widely accessible to most families living in modern societies, but so commonplace as to no longer be remarkable. Although some adults find it surprising that students pick up the skills needed to use technological items without seeming to need instruction, it is evident that the demands of using a television remote control, a mouse, or on-screen instructions are not necessarily more of a challenge than other tasks they need to master: getting dressed, using a pencil, and so on (Plowman et al., 2010).

Research has shown that digital technology is not a defining feature of students' lives but is just one of a range of activities in which they engage on their own or with their peers and families. As educators know more about how these students see the digital media in their lives, they must also review new learning styles and teaching strategies to meet students' needs that arise from well-thought-out usages. Educators do need to overhaul education to teach students who are born in the digital era. There is no practical achievement in the use of digital technology in teaching if educators, administrators, or parents believe it to be simply a trend (Palfrey & Gasser, 2008). If educators can make it possible for these students' digital experiences to become integrated with core knowledge content in a compelling way, students might fuse their attention to schooling more actively and with a greater sense of fun, resulting in a true passion for learning. These new alternatives make educators re-think the dominant role of K-12 public schools in education, as students and teachers spend more time learning in new digital venues (Collins & Halverson, 2009).

Scratch

Throughout the history of learning, educators have talked about innovative education designed to create students' interest in thinking differently, where the priority is to facilitate a kind of learning through creativity and problem solving (Sutton, 2006). Scratch, developed by the Lifelong Kindergarten research group at the MIT Media Lab in collaboration with the UCLA Graduate School of Education and Information Studies, is one of the techniques aimed at creating this new form of thinking in education. *Scratch* is a programming environment, designed to be simple to learn (EduTech, 2011), that enables students to create their own interactive stories, animations, games, music, e-portfolio, and art. It allows them to share their creations with one another over the Internet as well as in their individual study environment. The ultimate goal of Scratch is to help students become fluent with digital media so they are empowered to express themselves creatively and make connections with new and powerful ideas in the digital age (Education 2020, 2011).

Scratch builds on the long tradition of Logo[17] programming and takes advantage of new computational ideas and capabilities, making it easier for students to get started with programming and extend the range of what they can create and learn (Education 2020, 2011). To create Scratch programs, students snap together graphical building blocks that are individual modules of programming tools, each representing a different command or action. Students learn important computational ideas as they transform images, mix in sound clips and drum beats, and integrate input from real-world sensors (Sutton, 2006) or objects. As young people create and share Scratch projects, they learn important mathematical and computational ideas, while also learning to think creatively, reason systematically, and work collaboratively ("About Scratch," 2011).

When most people talk about computer science, they often forget about the use of media in accessing and delivering creative ways of learning. Scratch offers this potential. Bertram (2002), a professor at the University of Illinois at Urbana-Champaign, explained

[17]Logo is a computer programming language. It was designed as a tool for learning and provides the interactivity, modularity, extensibility, and flexibility of data features. The interactivity of this approach provides the user with immediate feedback on individual instruction, thus aiding the learning process (Logo Foundation, 2011).

that we, emphasizing the mediated aspect of technologies, view the effects of technologies as operating to a large extent through the ways they alter the environments for thinking, communicating, and acting in the world. Scratch provides a new way of learning in the sense that the movement and evolution shown by the program modules and with the program's use allow the subject matter to become more alive as it progresses and grows from the users' commands. With the increased fluency of the learner, the work product evolves. These new media include a wealth of materials, such as text, voice, music, graphics, photos, animation, and video. But they provide more than abundance (Vaegs, Dugosija, Hackenbracht, & Hannemann, 2010). Bringing all these media together means educators can vastly expand the range of learning experiences and open up contemporary and modern viewpoints to the educational environment. Students explore the relationships among ideas and thus experience more connected forms of learning. Most importantly, these new media are interactive and are conducive to active, engaged learning. Students can chose what to see and do, searching for more information through other media, and then, using Scratch to extend what they learn, can achieve more comprehensive presentations of their knowledge. Learning is driven by the individual's need and interest (Vaegs et al., 2010). Today, digital media technology such as Scratch provides users with pioneering, contemporary, and experiential methods to both foster and draw upon students' natural impulses towards creative thinking for the 21st century modern society.

Scratch is an educational programming language created with a graphical interface, which makes learning more fun and intuitively understandable. It has been used to create fun and educational projects as well as prototypes for educational games; and for teachers, it is directly used in the learning process. Additionally, researchers at MIT set up a Scratch website as an online community where the members can publish, remix, and share their projects; discuss and learn about their experiences in online forums; and build networks of friends and collaborators. In other words, the Scratch online community is an "affinity space" in which people learn (informally) through participation (Education 2020, 2011). The community has grown very fast and, after one year of being online, has reached 149,286 registered members, displaying 200,273 projects in 2008 (Lombana, 2008).

Decades of research have shown that students fed solely on a steady diet of facts and isolated skills cannot apply what they might learn or know to real world problems. They do not consistently achieve today’s best results, based on available innovations in education. Shaffer and Gee (2005) stated that innovative work cannot be standardized. The knowledge, skills, and contemporary thought found in professional educational environments and amongst modern educators become experimental practice. Educators and students may learn to be creative by becoming part of a group of people with shared knowledge about, and ways of addressing the problems of education in the world today. The Scratch program allows students working on a project to make the subject matter personally meaningful by immersing them in rigorous professional practices of innovation. In this approach, students do things that have meaning to them and society. The Scratch program supports them all along the way with structure—structure that leads to expertise and an ability to think and act creatively.

Shaffer and Gee (2005) hinted that projects produced with the Scratch program help students learn to work and think as inventive professionals and develop the epistemic frames of innovation. Students enjoy working in this environment and show all the indications of having fun, because they are using digital media programs, such as Scratch, for inspiration in thinking differently and creatively. And in the process, they are achieving a mastery of complex domains. Such projects are about knowledge, but they are about knowledge in action—making knowledge, applying knowledge, and sharing knowledge. These projects are more rigorous, motivating, and complex, because that is what characterizes the practices of creativity upon which they are modeled.

Scholars have argued that the way to prepare students for a world that rewards innovative work is to move beyond both traditional progressive reforms and the staid back-to-basics approaches. The key is to understand how new digital technologies make it possible to develop post-progressive pedagogies of practice (Shaffer, 2004). Digital media projects produced by Scratch represent one type of exploration that helps students learn to use the techniques of communities of inspiration—ways of learning that are immersed in practice and supported by structures, leading to natural forms of expertise, professional-like skills, and innovative thinking.

At the Limits of Literacy: Educational Responses to Digital Media

Literacy has been described as the ability to read, interpret, and construct texts and to gain the intellectual capacities required to fully participate in one's culture and society (Jenkins et al., 2009). Both traditionalists and reformists would probably agree that education and literacy are intimately connected (Kellner & Share, 2007). Additionally, literacy is also involved with effectively learning and using socially constructed forms of communication and representation in relation to various institutions, cultivating competencies in all forms of literacy (Kellner, 2000). However, Sumara

(1996) and Rosenblatt (1978) contended that in the context of digital media, literacy does not have the same relationship to language that it must have when it refers to the ability to read and write. Moreover, it does not invoke the complex subjective relationships of interpretation associated with many studies in literacy theory. Literacy evolves and shifts in response to social and cultural change as well as with the continuing emergence of new technologies (Kellner & Share, 2007).

Today, literacy can also be expressed as "new literacy" (Brushwood Rose, 2003) or as the conveyance of and for knowledge in the 21st century, as discussed in Schrum and Levin's (2009) book, *Leading 21st Century Schools: Harnessing Technology for Engagement and Achievement*. For example, literacy can be expressed as the interface used, such as in word processing: A mouse and tactile/vocal interfaces are extending knowledge itself as well as the access to knowledge from the abstract level of categorization to the practical one of sensory contact (Rivoltella, 2008).

In the traditions of reading, writing, and print literacy, several educators have stated that in an era of technological revolution, individuals must develop robust forms of media, computer, and multimedia literacy (Kellner & Share, 2005). The theories of literacy being applied to education are then found to be cultivating a new literacy in the restructuring of education (Schrum & Levin, 2009). *New literacy* involves not only ways of understanding, interpreting, and critiquing media, but also the means for creative and social expression, online search and navigation, and a host of new technical skills (Brushwood Rose, 2003). New literacy extends the symbolic manipulation skills of traditional print media by integrating video, images, music, and animation comprehension. With the explosion of digital media content and access devices in recent decades, researchers have presented evidence that there is a need to stress new literacy for today's forms of education and communication. Being literate in the 21st century requires more than knowing how to read, write, and do arithmetic. The Partnership for 21st Century Skills defined the necessity of information and communications technology (ICT) literacy as new literacy and the ability to use technology to develop 21st-century content knowledge and skills in support of 21st-century teaching and learning (Schrum & Levin, 2009).

The proliferation of today's broader forms of literacy position digital media as transparent technologies of discrete skills and practice. In stark contrast to other contemporary approaches to literacy, the approach of digital media is simply understanding texts and media as technologies of subjectivity, requiring interpretation (Brushwood Rose, 2003; Gee, 1990; Rosenblatt, 1978; Sumara, 1996). Brushwood Rose (2003) stated that educational experts who study these "new" media have, in many ways, reinvented or recycled the idea of literacy to describe other relationships with media forms, rather than simply reading or technical abilities. This includes those forms concerning the techniques and systems of the media themselves. Because digital media have emerged within a sociocultural context dominated by literate practices, educators must consider that negotiation of the media becomes our normal way of relating with the broader world (Rivoltella, 2008). This describes a way to address new forms of representation that simultaneously seem both closely related and unrelated to the literate representation of the information world (Brushwood Rose, 2003).

Again, the world we live in today is very different than the world most of us remember from our childhood. The 21st century is a media-saturated, technologically dependent, and globally connected world (Kellner & Share, 2007). People are now using networked digital media for their ongoing business and social exchange. Young people are leading the way in using digital media to expand, if not eliminate, the boundaries between personal communication, work, and learning. On their trip to Hong Kong, Carrington and Robinson (2009) made the following observation of the people and their lifestyle with regard to digital technology:

> They are immersed in hand-held games, movies, and conversations, all of which require digital literacy and the digital technologies that produce and distribute digital texts. They are not using *just* text, nor are they using *just* a digital artifact, nor are they *just* using audio and visual cueing systems. They are using a new form of text to do both old and new things; to maintain important intimate relationships, to sustain connection to older forms of text by using new technology to access it, but also to read in new ways, to open up and make use of new social, political and economic spaces. (p. 166)

New digital communication is spreading rapidly worldwide and having a deep impact on the way we interact and communicate, both in everyday life and in our professional activities (Cantoni & Tardini, 2008). The rapid growth of these new technologies, as well as the issue of new literacy, has created a division between those who can manage them easily and those who need supplemental education. Other boundaries appear between those who are Digital Natives and those who have "migrated" into digital technologies (Cantoni & Tardini, 2008). The development and impact of new forms of information and communication have contributed to the acceleration of the processes of social modification (Morcellini, 2008). Being able to publish online information, retrieve information, and/or participate in the activity of communication has become a part of social, commercial, cultural—virtually all—aspects of our life. The learning of new literacy is a necessary act, as the media and digital technologies used increasingly become forms of everyday use and are subsequently powerful systems of measurement and influence to construct the meanings and interactions of those who use them.

A media network is far more than simply an environment for the transmission of knowledge (Cukier, 2007). Digital media networks support existing forms of information distribution interacted between peer groups or specialized niche interests. The presence of social communication, professional media, and amateur niche media in shared online space introduces symbols, ideas, and values for learning by participation. Digital media, more than any other type of medium, become an expression of new social and cultural conditions (Morcellini, 2008). Ranieri viewed digital media as a society of knowledge, a lifestyle, and an expectation of modern society (as referred to in Morcellini, 2008). New literacy is a requirement in a knowledge society. Being able to access digital information is something that is no longer dependent upon “digital scribes”; rather it is becoming more and more a personal requirement (Cantoni & Tardini, 2008). The texts of social networking, games, blogs, wikis, and Facebook are about creating and operating within complex new social spaces. Digital texts are used to navigate, socialize, work, and maneuver within these cyberspaces (Carrington & Robinson, 2009). For many young people, their learning experience comes from applying their researching and observing to living; it crosses a range of social fields that includes both media networks and cyberspaces. In turn, young learners create forms of texts that enable and support their lifestyle.

I agree with Brushwood Rose (2003) about the notion that a purely skill-based model of literacy offers educators only two primary visions of the student/subject: first, as “carrier” or databank of skills and competencies that are meant primarily to facilitate students’ success as future workers; and second, where they are using cognitive models and computer metaphors that are offered up to describe the subject as an information processor. Several schools have integrated “computer literacy” or “technology literacy” into the educational setting but do so purely as a skill and not an evolving and living form of communication, interaction, and method to facilitate active inquiry. If teachers simply teach students with “drill and practice” software while approaching digital media as a list of tools, students do not interact with the media and the world it describes.

> Even schools with a strong project-based focus on technology—which aims to integrate technology through classroom projects rather than as an isolated subject—develop curriculum guidelines and tools for assessment that reduce the use of digital media to a list of technical skills. For example, a set of curriculum guidelines for “technology projects” developed in an Ontario school describes a series of digital design experiences for students in the elementary grades. Its rubric for assessment, rather than emphasizing the complex aesthetic and epistemological work of designing a digital text, lists the technical skills that should be acquired by students, including “log on and off,” “using mouse,” “connect printer,” “use tool bar buttons,” etc. (Brushwood Rose, 2003, p. 37)

Further, Brushwood Rose (2003) posited that although they may have originally been formulated as a list of skills or techniques, this proliferation of literacy also points to a more recent shift in thinking from the perspective of conceptualizing computer technology as an inspiration to a preoccupation with multimodal representation. New practices with digital text challenge older forms of authority in relation to knowledge production and expertise. These digitally enabled educators also challenge an older view of digital literacy as ancillary practices, positioned as a form of engagement with meaningful and powerful core knowledge, made more meaningful and powerful via the conveyance of digital technology.

The new literacy of the Internet and digital media provides individuals with opportunities to make their personal lives more productive and fulfilling (Schrum & Levin, 2009). Technology and information will continue to influence academic life, work, and personal environments (Sharkey & Brandt, 2008). Teachers must be prepared to teach in schools that are integrated into a world where technology, particularly portable digital technologies, are changing the ways in which we both see and make meanings as well as engage with each other (Carrington & Robinson, 2009). Although the gap in literacy and participation skills creates new challenges for educators who struggle to bridge the media-engagement gap inside and outside the classroom (Ito et al., 2008), some scholars and educators for the digital age are approaching these challenges with new and innovative solutions. Educators should recognize participation and collaboration as central to the way a future society will function and thus see these not as schoolroom skills but as lifelong competencies (Jenkins, 2006b). The challenge is in how educators address these changes and mold their evolution to help more people think about the digital media they encounter as participants in a digital society and the influence this has on their use and application. Digital media are part of the redefinition and broadening of existing boundaries of practice and educators' understanding of what learning means.

Lifelong Education

Lifelong education means education resulting from the integration of formal and informal education so as to create the ability for a continuous lifelong development and advancement of the quality of life (Rojvithee, 2005). When taken together, the cumulative effect of digital technological innovations is to extend learning throughout life (Collins & Halverson, 2009). Lifelong learning is oriented to the future, based on development of the human potential of individuals, led by information-gathering-and-using skills, and focused on learning and learners (Longworth & Davies, 1996). Learning is therefore part of life, which takes place at all times and in all places. The digital technologies of today make learning an activity that is integrated into life versus the separation of school, play, and work.

The terms, *formal* and *informal learning*, have nothing to do with the formality of the learning itself, but rather with the direction of *who* or *what* controls the learning objectives and goals (Werquin, 2010). In a formal learning environment, the training or teaching" department sets the goals and objectives, whereas informal learning means the learners set the goals and objectives for themselves (Cofer, 2000) or the goals and objectives are encountered randomly. Digital media technology offers a choice for the use of a digital application(s) and learning approach. Learners are creating their own blend of physical and virtual environments and of informal and formal learning context (Sharpe, Beetham, de Freitas, & Conole, 2010). The strategy of lifelong learning is evolving toward reliance on participation. The link is the relationship between learning in formal settings and the development of strategies for informal and digitally mediated learning (Walker, Jameson, & Ryan, 2010), and a training system (Field, 2006).

Lifelong learners in the digital society often use personal digital assistants, which can be connected to the Internet, to access their learning environment and communities (Collins & Halverson, 2009). Many young learners naturally mix their learning activity, communication, and everyday life, supported by personal technology and institutionally provided tools (Creanor & Trinder, 2010). Research has found that young learners who are intensive users of various technologies have relatively good information and communication technology skills, and can be very creative and competent while they interact with formal modes of education (Holm Sorenson as referred to in Dirckinck-Holmfeld & Ryberg, 2010). Jenkins et al. (2009) emphasized these as participatory skills, defined to include play, performance, simulation, appropriation, multitasking, judgment, networking, and negotiation. Today's students undertake critical engagement and active participation in both traditional academia as well as informal digital-media learning approaches. There is evidence that young people gain rich experiences and skills through their informal use of technology in a formal education setting (Dirckinck-Holmfeld & Ryberg, 2010; Holm Sorensen, 2005; Holm Sorensen, Jessen, & Olsen, 2007; Ito et al., 2009). Educators need to consider the new context of how learners' informal practices with technology and digital media can support their formal studies (Beetham & Oliver 2010) and enhance the total learning experience.

The ubiquity of digital media technologies and the information they constantly impart to us assures us that learning can be unceasing in our lives. However, the fact that we are driven to experience greater opportunities to learn in different places and in different ways has the potential to dilute the quality of learning experiences (de Freitas & Conole, 2010), where discrimination and critical thinking may perhaps be lacking due to either or both the volume and speed of information. These digital technologies change educators' attitudes and approach to formal education (Walker et al., 2010) and support learning activities and lifelong learning at every turn. Further, the quantity is immeasurable; thus well-informed learners must develop filters or ways to separate from the steady stream of knowledge that which is important, relevant, and meaningful to the task(s) at hand.

Longworth and Davies (1996) stated that lifelong learning is not a didactic technique but rather an attitude, a way of life, a process, a habit of mind, and an environment. It conveys a sense that it can help us see the world in a different way (Field, 2006; Nolan, 1999). Although we believe that digital media technologies have become an overwhelming part of our lives, Field (2006) emphasized that the outcomes of lifelong learning include skills, such as learning how to learn, application of new knowledge, critical reasoning, and information management and processing. Additionally, problem solving, effective communication, and desirable attitudes, such as cooperation, flexibility, adaptability, openness to new situations, and the valuing of knowledge and opportunities for their own sake, are developed. As a goal for today's educators and learners, we must choose learning to improve ourselves and for the joy of learning versus learning to pass some arbitrary test or apply for the next level of our corporate or pedagogical hierarchy. Of these two approaches to learning, the former is increasingly seen as a participatory process, involving the continuous reworking of meaning and knowledge (Field, 2006; Jarvis, Holford, & Griffin, 1998; Lave & Wenger, 1991), where learning is then fully integrated into our daily lives instead of being a task separate and apart from our natural life experiences. About lifelong learning, Tapscott (2009) contended,

> The ability to learn new things is more important than ever in a world where you have to process new information at lightning speed. Students need to be able to think creatively, critically, and collaboratively; to master the "basics" and excel in reading, math, science, and information literacy and respond to opportunities and challenges with speed, agility and innovation. Students need to expand their knowledge beyond the

> doors of their local community to become responsible and contributing global citizens in the increasingly complex world economy. (p. 127)

Innovative digital technologies are considered new models and metaphors for bridging between pedagogies, instructions, and performances (Koehler, 2006). Digital media serve as a new metaphor for the exploration of learning concepts. Digital media offer new modes of expression (Walker et al., 2010) and collective knowledge. Young learners can develop advanced learning capabilities and critical, academic knowledge through their informal use of technology (Dirckinck-Holmfeld & Ryberg, 2010). Learning for life is no longer a policy buzzword but a requirement for individual well-being (Beetham & Oliver, 2010) and advancement. If these terms are accurate descriptions of today's reality, then we will learn from the interaction between society and the changes inherent in harvesting this new learning.

> In this rapidly changing context, it is increasingly difficult to specify the skills that learners will require even a few years into future. At the same time as this uncertainty has beset the curriculum, the line between formal education and other kinds of learning and knowledge acquisition has become blurred. Digital media creates vast new opportunities for individuals to learn outside of or alongside formal learning, challenging the unique role of educational institutions. (Beetham & Oliver, 2010, p. 160)

Knowledge Revolution

In the 19th century, the Industrial Revolution turned the universal schooling movement from an evangelical form to a practical necessity (Palmer, 1965). For most Americans then, the Industrial Revolution not only attracted citizens from the farms to the cities. It also fueled one of the most thoughtful periods in education and governmental policy for the creation of social cohesion to give the new immigrants a common language and understanding of American democracy in schooling (Cowan, 1997). Collins and

Halverson (2009) contended that we are now going through another revolution on the same scale as the Industrial Revolution. It is variously called the *knowledge revolution* or *information revolution* and is driven by the technologies for processing and communicating (Chichilnisky, 1998), such as personal computers, the Internet, mobile phones, and video games. Just as the Industrial Revolution led to the development of universal schooling, some educators believe the knowledge revolution is leading to a new era of lifelong learning. A number of people have started to realize that information itself will not bring important variations to learning and learning outcome. Rather, the key is how people transform information into knowledge and how they manage and share that knowledge (Resnick, 2006). Kressel and Lento (2007) believed that the knowledge revolution will inevitably lead to world-changing events and that visionaries may be able to see beyond present conditions to predict which inventions will be successful. Chichilnisky (1998) stated that the knowledge revolution represents a new pattern of economic growth, replacing the resource-intensive pattern that has prevailed since World War II. This leads to a new vision of society that is very innovative in the use of knowledge and the service of knowledge in life.

The knowledge revolution refers to a global-scale paradigm shift that many compare to the agricultural and Industrial Revolutions and is driven by the advent of information and communication technologies (Ma, 2009). Some, such as Kressel and Lento (2007), have suggested that it all began when the most complex electronic device in the average American home some 50 years ago was a black-and-white television. It usually received only three or four channels that were limited by time. Compare that medium and period with the media-rich, information-intensive environment in the 21st century. Contrast that experience with television entertainment today, which is broadcast in high definition with live audio and video on hundreds of channels (Kressel & Lento, 2007). We can enjoy programming on television or via websites through our personal devices literally 24 hours a day. Another good example would be the new way of communication, referred to earlier. Calling Taiwan or Greece is not an expensive long distance phone call as it was 20 years ago. No longer is there an implied importance or urgency to a call prefaced with, "I am calling long distance." And in regard to the computer, today we carry around a laptop, or even our mobile phone, with millions more circuit devices and vastly greater power than the behemoth corporate number crunchers of the 1980s (Kressel & Lento, 2007).

The knowledge revolution represents a transformation from industrial production to service (Chichilnisky, 1998). The combination of information and communication technologies is seen as leading to a flattening out of social hierarchies, because every user becomes a producer as well as a consumer of media, able to circulate individual opinions, products, and abilities (Press & Williams, 2010; Trippi, 2005). Other arguments suggest that these technologies will obliterate time and space as we communicate across the globe, regardless of distance or time zone, and that itself will have an "inevitable" impact on our sense of place, identity, nationalism, and more (Press & Williams, 2010; Shirky, 2008).

Kressel and Lento (2007) posited that all of these adaptations have altered more than the size and power of our digital media usages; they have changed our way of life. Collins and Halverson (2009) suggested that knowledge-age technologies emphasize access to allow people to pursue their own interests and goals. People can communicate with others wherever they find information on virtually any topic. They can also participate in games and activities that provide immediate feedback on their performances. Through the Internet, people can control what they do, with whom they communicate, and even who they are or appear to be.

Knowledge has always been the driving force of change in human society (Chichilnisky, 1998). The knowledge revolution has gradually transformed work over the course of the 20th century and into the 21st century. Shoshana Zuboff described how a variety of jobs have changed to become much more knowledge intensive (Powell, 2004). For example, a secretary's job has changed from typing documents to handling interaction with people through the Internet and a phone-like device. A fisherman gathers information from the Internet regarding the condition of the sea, weather, and navigation, and understands operating his ship's machinery and GPS (Global Positioning System) as if all these technologies were seamless to the act of fishing. The computerization of work puts a premium on skills of accessing, evaluating, and then acting on information. In turn, the gap between college-educated and non-college-educated members of society has been growing by virtue of the college students' exposure to and use of technology. The knowledge revolution leads inevitably to the advent of the knowledge society, which is global in nature, deeply innovative in and dependent on the use of "human knowledge" (Chichilnisky, 1998).

It is in this broader conceptual sense that terms, such as knowledge society, information society, or learning society, really do have some degree of analytical power. Barnett (1990) suggested, "Knowledge has become so important to modern society that, if it has not yet become the base itself, it is at least definitely integrated with it" (p. 67). If these terms are accurate descriptions of today's reality, then we may learn from this interaction with society and its changes, as mentioned earlier. This new knowledge and the methods of harvesting and creating knowledge may grant educators greater educational success.

Educational Responses to Digital Media and Technology Today

> To stay relevant in the 21st century, education institutions need to keep pace with the rapid changes introduced by digital media. Youths' participation in this networked world suggests new ways of thinking about the role of education. (Rosen, 2010a, p. 39)

Education faces profound challenges. From the dawn of the industrial era, people have had their entire library of experience presented by the then-contemporary technologies surrounding their lives. The advent of the knowledge society also forces individuals to adapt to new ways of living and learning. The move to the digital media era has brought the impact of new technologies, significantly transforming learning and teaching within and without the school environment. Many of today's schools, teachers, principals, and educational leaders now find themselves recognizing the increasing importance of shifting to a model of schooling appropriate for education in a digital world (Finger & Lee, 2010). Educational leaders are demanding the process of successfully adapting digital media for their school communities and educational systems. The pure ubiquity of digital "everything" mandates that education evolves and leads the way to new forms of learning. Buckingham (2007a) raised the questions: "How should schools be responding to the role of digital media in young people's lives?" (p. vii). Can educators find ways of engaging with learners more critically and creatively, based on their life experiences with these technologies? Gee, a professor and member of the National Academy of Education, commented,

> Given that the digital age is enveloping our world, and its influence is not likely to decrease, educators need to meet the emerging challenges on two fronts. Educators must determine the new learning styles of students and develop educational methodology and teaching strategies to meet learning needs. (as cited in Rosen, 2010a, p. 3)

Today's young people can be defined as learners—as persons with intellectual, physical, social, emotional, moral, and spiritual talents and capabilities; and as contributors to society. Accordingly, curriculum developers and teachers within the modern educational system are faced with the task of educating this unique audience (Lee & Gaffney, 2008). It is in this context that educators must take up the rapidly evolving forms of digital media and integrate them into modern learning.

Within these actual changes and effects of the digital era, there are wide varieties of thought in the context of education. Lee and Gaffney (2008) raised serious questions about what is taught, how it is taught, and what is learned. Today's students and tomorrow's teachers are different from previous generations, and digital technology has become seamlessly entwined throughout their lives (Schrum & Levin, 2009). Zhao (2003) contended, in his book, *What Should Teachers Know About Technology*,

> Educator knowledge not only points out that technology knowledge should not be limited to using technology as a tool, but also strongly suggests that teachers understand how technology affects students as well. Today's students grow up in a technology-mediated world and their thinking, behaviors, and emotions are heavily influenced by new technology (Tapscott, 1998). Teachers' knowledge of technology should be expanded to include technologies that students interact with as well….Instead of treating technology knowledge as a separate entity of teacher knowledge, I suggest that we view it as an integrated part of teacher pedagogical knowledge and pedagogical content knowledge. (p. 8)

Recently, some educators have tried to apply the traditional models of learning by using new technology devices. However, using technology does not mean the curriculum has attained a true understanding of using technology for teaching. For example, online education simply took the same content and organized it to be delivered without a teacher physically present (Li & Akins, 2004). Electronic classroom tools, such as online videos, PowerPoint presentations, and high-tech presentation equipment, were only being used as linear methods of delivery and receipt. New digital technologies were used, but they were utilized in old analog ways. Certainly these technologies made education more interesting and allowed for the opportunity to present content in different ways, but they were still tied to static material presented in a static learning environment.

Today's learners need something more attuned to their daily lifestyles—connected and often more productive with the use of these technologies (Rosen, 2010a). It is essential to remember that people are more important than technology (Finger & Lee, 2010), and effort should be made to connect the learners with content. A key concept here is "connection" in that the technology allows the learner to become part of the content via his/her interaction with it. According to Rosen (2010a), educators need to understand how students are different in the ways they value and approach digital media and technology. It is not only that students are using more up-to-date technologies, but also that they approach technology differently than their teachers and even their older college-age siblings. If educators can better understand how these students process multimedia technology, they can then more creatively imagine how to teach them and how to select or develop curricula that will engage these tech-savvy learners (Rosen, 2010a). Educators need to acknowledge that computers and other digital media are technologies of experience, because these digital technologies support the value of knowledge retrieval and assist students' interest in learning. The key to success in teaching and learning is in being able to connect abstract thought in core knowledge with concrete experience representing the latest knowledge and information (and practices and skills), in a way that connects with students' accumulated body of experience (Stern, 1997).

Schrum and Levin (2009) discussed two types of activities that use education technology within the curriculum. Type I activities utilize technology tools for productivity purposes. Simply put, these are activities where students "carry out a specific task in a learning situation" (Kongrith & Maddux, 2005, p. 110)—students' learning is limited to the use of tools, such as word processing, Internet searching, and presentation programs in order to reduce the amount of instructional time to complete the task. Type II activities are designed to change the nature of teaching and learning. These activities promote dynamic interaction with the breadth of human knowledge (Kirschner & Erkens, 2006; Kongrith & Maddux, 2005; Schrum & Levin, 2009). In addition, users are invited to actively exercise control over the content for creative productions, evidencing their inquiry and knowledge, while utilizing these technologies. A Type II activity is exactly what I endeavored to uncover in this study—a great example of quite literally forcing students to develop their own work versus their merely being a passive receiver of data. Students participate with the learning environment and develop knowledge with their own authority, because they are empowered by interaction with the material and encouraged by their own imagination and creativity. Students use technologies to actively solve problems rather than passively listening (Zhao, 2003). The potential for students is to take control of the “means of production”—to use technology to communicate, to become creative producers of media, and to present their perspectives and concerns (Buckingham, 2007a). Educators need ways to think about their relationship with technology as being complex, dynamic, and continuously evolving, through which they develop sophisticated and nuanced understandings of the capabilities of technology as well as its constraints (Zhao, 2003).

Today, digital technologies form an integral part of everyday functions and operations of the facets of our lives. These digital technologies are important resources for supporting delivery of the curriculum and the achievement of a specific outcome, whether that outcome is mastering a specific task or attaining a defined level of knowledge or understanding within the context of education. They should be integrated rather than viewed as “add-ons” or ends in themselves (Lee & Gaffney, 2008). Whereas some teachers view technology as complex appliances, their issue should be to convey learning and teaching with the active interaction between teachers and students, making the teachers’ job more fluid and engaging, and maximize their general expertise as educators and within specific subjects. Technology is not a substitute for the relationship between teacher and student, nor does it supplant the invaluable work of a great teacher (Black, 2006). The best possible outcome of better integration of digital media into education is to further the innate commitment to learning of educators, administrators, and the entire education community. The goal is the thoughtful incorporation of digital media throughout the learning experience (Lee & Gaffney, 2008). It will be the educators’ deliberation on these issues, in the context of their expertise, which will achieve new levels of inspiration, making learning in the 21st century ever more dynamic and successful.

Digital technology has offered schools the opportunity to consider that technology has become an essential component of the transformation of schools. Many people believe that the impact of technology will depend partly on technical factors but, more importantly, on the choice people make about how to use digital technology (Zucker, 2008). It is important that teachers apply techniques that are up-to-date and authentic to achieve ways for current learners to find credibility with the forms of digital media used. Often the learner is more adept and fluent in these technologies, so currency and credibility are keys to success. The resources are now ready to provide for interaction and, in turn, the learning of essential skills, knowledge, and more. The creation of learning experiences that takes advantage of these unique experiences is the key to meaningful changes in education (Bai & Ertmer, 2008; Schrum & Levin, 2009) and serves to recognize digital media technology's role in schooling.

Education Approaching the Digital Media Environment

The need is in learning about the potential benefits and costs of new technologies, building their capability, taking strategic action, and playing an active role in decision making. Learning implementation and its outcome results directly from investment in digital technology in the broader school communities and specific school systems (Schrum & Levin, 2009). In addition, it is very important that educators embrace the potential of digital technology and encourage the use of it in schooling. If technology is to be integrated into the curricula, the concepts themselves must also be integrated into the philosophies of the school.

New tools and resources used in educational settings are being developed constantly (Schrum & Levin, 2009). Many schools have stated that their curriculum and environmental or infrastructure goals are to become the model for 21st century schools. However, although most digital technologies and concepts have been introduced to the classroom, most teachers are not fully engaged with the potential for their problem-solving ability, nor do they see such technologies and concepts as a mandatory requirement for their students. Teachers' knowledge about technology is normally situated in the context of what technology can do for them (Zhao, 2003) and is often limited to their own productivity in content delivery and administrative tasks, such as reporting. Providing teachers with strategies about how technology can be used to achieve learning outcomes and creating an environment that encourages creative and independent use of technology as well as promotes student skills in using digital technology (Schrum & Levin, 2009) is the goal.

Along with quality teachers, the effective development of digital media education requires educational leadership and management to acquire the capability to lead (Lee & Gaffney, 2008) and support the entire educational process in the use of digital media. Without that commitment and knowledge, teachers have little chance to fully utilize a digital media curriculum that is contemporary with the environment of their students. Getting teachers to be more involved and feel comfortable with digital media and technology in everyday use is not an easy task, yet educational leaders acknowledge the value of digital technology and advocate its use and integration with today's curriculum. Successful learning in a knowledge society requires all participants to conduct themselves with openness to the possibilities of digital technologies, enhancing students' engagement and learning while improving teaching practices. To meet these challenges, educators need to have a general understanding of the digital technology infrastructure in their school, and also hold effective oversight on how that technology is being used in classrooms for teaching and learning that is responsive to the digital environments of their students (Lee & Gaffney, 2008).

According to Schrum and Levin (2009), a recent CDW-G study provides a glimpse into teachers' thought processes regarding the use of technology. Respondents to surveys of CDW-G, a leading provider of technology products and services, stated that they are moving from learning how computers work to being able to use technology to change how they teach, and they believe this is transforming the process of learning (Cunningham, 2010). They believe that technology impacts the learning style and how we think, as well as the development of lifelong learners, by eliminating the notion that the educational environment is separate and apart from the life environment. By a better integration of the digital experience of life with that of learning, the notion of learning and living as distinctly different activities is eliminated.

For many years, the idea of technology in schools always meant computers and software, or specifically, investments in items that quickly grew obsolete and had somewhat limited uses (Schrum & Levin, 2009). Cuban (2001) indicated that although more schools are being "wired" and billions of dollars are being spent, teachers' motivation to use the technologies for instruction is not fully developed, managed, and shaped. These powerful technologies end up being used most often for word processing and low-end applications in classrooms that maintain rather than alter existing teaching practices. Statistics from the National Center for Education Statistics (as referred to in

Gray, Thomas, & Lewis, 2010) showed that in 2008, 100% of the schools reported having Internet access, and the ratio of computers to students was 1:3. Moreover, 39% of public schools had wireless network access for the whole school, 87% used networks or the Internet to provide standardized assessment results, 72% had data to inform instructional planning at the school, and 65% used high-quality digital content. These data show a lack of planning to integrate the entire digital world from connectivity to actual use. Whereas Schrum and Levin (2009) commented that these figures do not represent the complete picture and each school has its own policy, nevertheless, these statistics provide evidence of a disconnection between what is out there and what is being used in day-to-day practice. Merely having a "connection" does not automatically confirm well-planned use. Cambre and Hawkes (2004) stated that although teachers have used technology for personal productivity and have attended a number of very diverse technology workshops, computers in the classroom have done little to change the process of schooling; they often sit as new, expensive toys in the corner of the classroom. In contrast, many of the authors I have referenced seek a well-thought-out process that begins by researching the use of digital technologies and how they impact teaching and learning; in turn, this information should be translated to a path towards organized implementation.

Digital technology infrastructure today is in schools on some level, but educators must provide effective oversight of how that technology is being used in the classroom to support teaching and learning (Lee & Gaffney, 2008). Educators have limited ability to integrate curriculum with digital technologies (Schrum, 1999; Schrum & Levin, 2009). Tapping into what teachers know about technology gets at the heart of their competence in everyday classroom teaching and would reshape the learning process to a more interesting form of connecting with students. Just imagine the connection that teachers could establish with their students if shared digital technology were part of learning. If digital technology is applied across the full curriculum, it will make a real difference in education. Thus, proactive educators need to communicate with more educators to evolve with these digital media learning environments (Zhao, 2003), while simultaneously communicating with the students and observing the technologies used in their day-to-day lives. Without this adjustment, teachers will find themselves facing the impossible challenge of how to communicate with their students and offer the best paths to knowledge (Cambre & Hawkes, 2004).

Understanding Students' Use of Digital Media for Learning

Digital media and networks have, in recent years, become a pervasive part of the everyday lives of students in most countries (Ito, 2008b). A large number of students spend more time with digital media of various kinds than they do on any other activities. Digital media technologies represent a relatively recent addition to this "media-saturated" environment, and they are far from equally available to all students (Buckingham, 2007a). If educators want to understand how to improve students' learning (Wiske, 2000), several scholars have stated that they need to understand precisely what students' interaction with digital media is and how students benefit from access to these digital media (Jenkins, 2006a).

Today, students have extensive skills in the use of various media networks and in sharing information with others through the Internet. Whereas students prefer to produce video, write text-based content, and/or host websites, often within the framework of social media such as Facebook, their skills, their willingness to experiment, their use of multiple personal technologies (Sharpe & Beetham, 2010), and their immersion in digital technologies prove them keen to try new things, often at high speed (Tapscott, 2009). While using imagination and creativity, students make technology work for them or use it for broadly enhancing both their passive and active pursuit of knowledge. Whether or not they are conscious of it, learning happens while students are engaged with digital media and its environment.

When Collins and Halverson (2009) spoke about “knowledge,” they referred to two kinds: Knowledge wherein people know a subject themselves, or knowledge as a result of people knowing where they can find information. Corsaro (1997) insisted that students’ learning is not just adopting and internalizing what is given but also reinventing and reproducing as they negotiate, share, and create with others. Tapscott (2009) made the point that digital technology is influencing the way young people think and behave with knowledge, which is a two-way street. Piaget’s constructivist theory of knowledge was based on the assumption that learners do not copy or absorb ideas from the external world but must construct their concepts through active and personal observation and experimentation (as referred to in Mayes & de Freitas, 2007). Technology apparently allows students to become actively involved in the learning process rather than passively receiving information (Buckingham, 2007a). It creates a more authentic mode of learning that connects students to the real world beyond standard schooling. New digital technologies are central to this new concept of learning. Under a teacher’s guidance, students are capable of understanding, making sense of, and communicating concepts, as well as strengthening ideas through a greater use of the digital devices pervasive in their lives.

When Rosen (2010b) spoke of the “mini generation,” he was referring to those who have grown up with digital media and therefore have different experiences than their older brothers and sisters, and certainly their parents. Prensky (2001) argued that these Digital Natives have a very different style of learning: They crave interactivity; they value graphics before words; they want instant access; and they operate at the “twitch speed” of video games, YouTube, MTV, and so on. We are now faced with fast-paced modes of information and communication in today’s world. Thus, students growing up in the digital age spend their formative years in an environment fundamentally different from their parents and teachers. These students long for a new form of education that is different from the experience of their parents or teachers and one that reflects their digital environment. As a result, these young people are not satisfied with old styles of instruction, viewing many of their teachers’ methods of operation as old-fashioned. The key question is, do educators understand the processes by which students learn today? Sharpe and Beetham (2010) gave this response:

> The challenge then is to bring the learning experience and digital media into alignment. When learners develop their skills, habits, practices and conceptions of learning, they do so in an environment that is now inherently digital. Even those learners who are making conscious choices to unplug from digital networks for some aspects of study, or who lack functional access to technology, can no longer be seen as developing in some non-digital bubble. The social world they move through, the work they do, the institution that accredits their learning, and the information they are handling, will all at some point be touched by the ubiquity of digital media and networks. To what extent do models of effective learning need to reflect the experience of learning in a digital age? (p. 86)

Whereas old-style education was teacher-dominated and authoritarian, digitally based education is non-linear and learner-centered, based on discovery rather than the delivery of information (Buckingham, 2007a). In this new world, the old knowledge hierarchies no longer apply, and the working environment is one of personal innovation and openness (Buckingham, 2007b). It is not what you know that really counts but how you navigate in the digital world and what you do with the information you discover. This is the new style of learning (Tapscott, 1998). Mayes and de Freitas (2007) emphasized that learning in the 21st century must be personally meaningful. Learning is also based on the idea of learning through relating to others. Learning is experienced through individual and group relationships. Digital technology supports new learning as a dialogue. Students learn how to look for information, analyze and synthesize it, and critically evaluate the information they find in a creative way. In this model, the role of teachers is becoming even more important (Feldman, 2000). Adults may stimulate students' cognitive development by giving them a learning objective when viewing materials of education (Wood, 1997). Many studies have shown that students' abilities to become proficient at something new may depend on what they already know. Educators can help by building on the foundation of already existing frameworks through problem-solving activity and feedback (Mayes & de Freitas, 2007).

Digital media technologies have become embedded in students' everyday lives and are part of broad-based changes to how students engage in skills related to knowledge production, communication, and creative expression (Ito et al., 2008a). Students are already exhibiting these skills in an informal setting and in the context of their lives. If, through formal learning, students can become more effective and discriminating networkers, better judges of the information they receive, and subsequently more credible communicators, they have the potential to be key participants in the digital age (Jameson et al., 2010). Digital technology is not the defining feature of students' lives (Collins & Halverson, 2009), but students can participate in active learning models where the learners are encouraged to be more deeply engaged in a wider variety of learning activities and take more responsibility for managing their own learning.

Learning Approach

Technology for K-12 learners can support and mediate students' learning, and the technologies encountered will afford or prompt learning in different modes (Plowman et al., 2010). Digital media in education have made the idea of learning an open-ended, interactive-based environment. An important feature is that students are able to collaborate with teachers, experts, and their peers without losing control of the modes and rates of their own learning process (Shaffer, 1997). An issue in the open-ended approach to learning-by-doing is the playful situation provided students as they effectively interact with the technology in learning activities.

Learning by Doing

Dewey (1938), in his book, *Experience and education*, indicated that we learn most effectively by "doing." Dewey meant that students will learn most effectively when their action of learning offers the opportunity to try out what they have learned with their own unique skills, either doing something they want to do or working with others to produce something that gives the chance to share their skills. Papert (1993) found that learners become deeply engaged by fun "doing," because the reward of fun motivates deeper engagement. Research has shown that many of students' best learning experiences come when they become attached to the subject through interaction (Papert, 1980; Resnick, 2002, 2006). Today's learners want to be active participants in the learning process—not mere listeners; they have a need to access the staggering amount of content and knowledge that is available at their fingertips (Johnson, Levine, & Smith, 2009). Students' everyday use of digital media and technology becomes a virtual location for providing opportunities to develop and encounter knowledge and/or inspire new forms of expression.

Vygotsky (1978) suggested that deep learning occurs through participation in practice, often with a loose collection of individuals with shared goals, who are, both implicitly and explicitly, engaged in continuous collaborative activities (Jones & Bronack, 2008). Learning is shifting from the aura of authoritativeness imposed in the "lecture and learn" model to the creation of an interdisciplinary, collaborative knowledge, and learning environment in order to address objects of analysis and research problems that are multidimensional and complex (Davidson et al. 2010). The results of learning are revealed through what students interact with while they are learning—the results provide evidence of what the learning via these interactions means to them (Ellis & Goodyear, 2010). The environment created by digital technologies has the potential to fundamentally transform how and what people learn throughout their lives (Resnick, 2002). The opportunity and challenge of digital media technology is that it allows learners to increase their advantage by accessing diverse resources in the expansion of knowledge. Learning by doing facilitates participation, expects interaction, connects with the person or material via a dynamic exchange, and deepens knowledge through active and extended engagement.

Shaffer and Resnick (1999) argued that the authenticity in truly motivated learning provides a potentially useful guide for digital media education. *Authenticity learning* includes a dialogue between activities and some combination of (a) goals that matter to the community outside of the classroom, (b) goals that are personally meaningful to the students, (c) ways of thinking within an established domain, and (d) the means of assessment. Shaffer and Resnick commented that digital media and other technological environments or forums can provide students with personal meaning to their work and a connection process to the broader world.

Digital media have put powerful uses in students' hands, making it possible for them to reach out, collect data, study, and subsequently, research, organize, and present their findings. The connectivity of digital media makes it possible for students to communicate with experts in various disciplines. It allows students to think about new and old problems in new ways, furthering the creation of new means of expression. Buckingham and McFarlane (2001) presented a goal for students: to take control of the "means of production," to use digital technology to communicate, become creative producers of media, and represent their perspectives and considerations. In these visions, digital media technologies reinvigorate Dewey's (1915) idea of learning by doing.

Play and Learning

Play refers to a range of voluntary, intrinsically motivated activities that are normally associated with pleasure and enjoyment (Garvey, 1990). Play often consists of an amusing, pretend, or imaginary activity alone or with another. The rites of play are evident throughout nature and are perceived in interaction, particularly in the cognitive development and socialization of those engaged in developmental processes. Recently, Bodrova (2008) pointed out that there is no single kind of play, but rather play that meets specific criteria: Students create an imaginary situation, take on and act out roles, and follow a set of rules.

The relationship between play and learning has become muddled with ideas about student-centered and progressive pedagogies that also emphasize exploration, experiential learning, and choice of joy (Plowman et al., 2010). Through interactive digital technologies, play and learning have become completely interchangeable and, in fact, are often the same thing. Resnick (2006) has focused on ways to integrate play and learning, based on his observation that many of people‘s best learning experiences come when they are engaged in activities that they enjoy and care about. When students explore, experiment, and interact through play, they learn how the world works.

Piaget noted that students’ ways of understanding and operating in the world can be categorized in making sense of the world through the senses (Glasersfeld, 1983). This results in action, moving to progressively internalize the manipulation of symbols and concepts until abstract and logical thought is reached. Lately, researchers have shown that students are able to do much more than Piaget’s making sense of the world through the senses. Experimental education has suggested that students are engaged in more meaningful tasks within the learning process (Scardamalia & Bereiter, 2006). Students were found to acquire new understandings in one area of development ahead of another or employ more or less sophisticated knowledge, depending on the circumstances (Plowman et al., 2010). Vygotsky (1978) argued that students acquire cultural tools they then share through their interactions, using this inheritance to make sense of and act in their world. Resnick (2006) emphasized that if students approach digital technologies not simply as information machines but also as a new medium for creative expression and exploration, this opens new opportunities for students to playfully explore and experiment with creativity and new forms of expression. Throughout playful experience, students learn to be creative, engaging in seemingly mindless interactions that evolve to passive consumption (Cordes & Miller, 2000; Oppenheimer, 2003) of vast sources of knowledge.

Siraj-Blatchford and Sylva (2004) found it was when play involved cognitive challenge and engagement in "potentially instructive play activities" (p. 727) that this made a positive difference in the effectiveness of play-fostered learning. Research has found that students become more engaged with digital technologies when learning takes the form of play and educational projects, and then grows out of their own personal interests (Roussou, 2004). When students deeply enjoy their projects, they are not only motivated, but also develop deeper understandings and richer connections to knowledge (Resnick, 2006). Resnick (2006) emphasized that digital technologies can support playful learning, and the playful activities can help students acknowledge and make full use of digital media technology.

Moreover, Resnick (2006) pointed out that digital technologies integrate the playful learning experience. However, some people misinterpret the spirit of playful learning as a reward of "edutainment"—education and entertainment. This problem may come from the observation that many of today's edutainment creators tend to stress and view entertainment as a source of comfort in their approach to education. Or they think that people would have so much fun using their products that they would not realize that they were learning. Here is Resnick's explanation:

> The terms play and learning (things that you do) offer a different perspective from entertainment and education (things that others provide for you), thus the phrase playful learning, as opposed to edutainment, conveys a strong sense of active participation. It might seem like a small change, but words we use can make a big difference in how we think and what we do. (p. 4)

With this in mind, learning should be playful. Plowman et al. (2010) insisted that digital technology can provide opportunities for learning, fun, communication, and self-expression. Young students are active participants in the learning process, making sense of their experiences in terms of modifying their encounter with new ideas in a playful setting.

Making a Game of Learning

Several studies have shown how students' informal learning experience can become a source of new approaches to learning. Prensky (2006) and Tapscott (1998) indicated the necessity for modification of what they regard as the old-fashioned drill-and-practice learning experience. Buckingham and Scanlon (2003) and Wellington (2001) believed that digital technology inherently fosters a more interactive, open-ended, and student-led style of learning. Many scholars suggested that by providing even more sophisticated dynamic interaction, digital technology-based learning environments are likely to make education much more engaging (Collins & Halverson, 2009). Gee (2003), in his book, *What Video Games Have to Teach Us About Learning and Literacy*, analyzed how interaction within video games is a new learning style for cognitive development that should be applied to learning today. Games provide an increasingly complex, customizable learning-by-doing environment. Games offer the prospect of user-defined worlds in which players try out (and get feedback on) their own assumptions, strategies, and identities (Collins & Halverson, 2009).

Gee (2005) argued that games involve processes of learning that are "deeper and richer" (p. 112) than the forms of learning to which students are exposed in traditional schooling. Shaffer, Squire, Halverson and Gee (2004) asserted that the availability of computer games today has its limits in relation to the learner's need. Rather than embedding "lessons" directly in games, researchers have focused efforts on providing students with greater opportunities to construct their own games, and new relationships with knowledge in the process (Kafai, 2006). In terms of making instructional education materials, the objective is to have developers and learners turn naturally to the concept of designing instructional games. Further, building on the "learning-by-doing" nature of games, researchers hope to make the learning of academic matters more fun. Making games serves the process of learning needs to be a well-articulated theory of learning, with sound pedagogy behind it and particularly one that emphasizes the expression of ideas, values, and genres. A pedagogy with such a design orientation can be found in constructionism, which places learners in designer roles and ties together the importance of designing artifacts that are of relevance to a larger community (Kafai & Peppler, 2007b).

Much of learning is carried out by active exploration—"learning by doing" (Buckingham, 2007a). Piaget is quoted as saying, "Knowing reality means constructing systems of transformations that correspond, more or less adequately, to reality" (as cited in Confrey, 1994, p. 2). Dewey argued that "education is not a preparation for life;

education is life itself" (as cited in Davis & Tu, 2008, p. 30). Making games addresses the development of modern forms of learning. Gee et al. (2004) noted that making games integrates knowing and doing, but not *just* knowing and doing. Making games brings together ways of knowing, ways of doing, ways of being, ways of living, and ways of caring. These all then become the realization of understanding effective social practices and shared values with others.

Games allow learners to learn how to manage their own lifelong learning and become creatively skilled at learning to learn (Gee, 2008). The act of being creative fosters a dialogue between the students and various forms of media. It creates a feeling of accumulating knowledge, skills, and communications, rather than standing passively to receive the assignment. Making games is of great importance to the learning process, because it lets people participate in the world together and then think, talk, and act—learners inhabit roles otherwise inaccessible to them. Not only does making games challenge and engross students in all sorts of educationally valid ways, but it also seems to provide an opportunity for some students who are not normally academically successful to boost their self-esteem by excelling at this rewarding activity. Kafai (2006) stated that by learning with and through making games, students are learning how to learn in a creative way. Students are developing particular orientations towards information, specific methods of acquiring new knowledge and skills, and a sense of their own identities as learners and users.

While learning to make games, learners begin to develop technological fluency. *Technological fluency* involves not only knowing how to use new technological tools but also knowing how to make things of significance with those technologies and most importantly, developing new ways of creative thinking based on use of those tools (Kafai, 2006). Beyond that, game-making activities provide an entry point for young learners to live and learn within the digital culture, not just as observers or consumers but also as producers and active participants. Klopfer, Osterweil, Groff, and Haas (2009) have observed that people making games can create worlds where people can have meaningful, new experiences in places that would otherwise never be allowed to them. Good game designers are practical theoreticians of learning. What makes games deep is that players are exercising their learning muscles, often without knowing it and without having to pay overt attention to the subject matter (Gee, 2005).

Designing games also influences engaged participation—a key part of motivation (Gee, 2008). Making games motivates students via fun, and challenge is a part of the natural learning process in human development (Bisson & Luckner, 1996). Learners must come to understand the design of the domain they are learning and the content message, so that they can make good choices about how to affect players. Games are interactive. Learners need to know the "rules of the game" and who plays it. The "author" (game designer) places several considerations at the disposal of the players. Students with different levels of experience, knowledge, and skills in learning through making games are aware of these gradations and how this affects their collaborative interaction (Ching, 1999).

In a good game, the player does something, and the game normally does something back that encourages the player to act again—challenge and response. In a good game, players feel that their actions and decisions, not just the producers' actions and decisions, are co-creating the world they are in and the experiences they are having

(Gee, 2008). Typically, students are keen to receive challenges. Students learn to be confident with creativity when making a game with an instructor's guidance. Distinct from project or problem-based learning, students develop deep understanding of academic content by creating meaningful products that reflect their knowledge of subjects, such as mathematics (Hall & Stevens, 1995; Harel, 1991; Kafai, 1995), science (Kafai, Ching, & Marshall, 1997; Cuthbert & Hoadley, 1998; Kolodner, Crismond, Gray, Holbrook, & Putembakar (1998), engineering (Roth, 1995), and social sciences (Ioannidou, Reppenning, & Zola, 1998; Kafai & Yarnall, 1996; Lehrer, 1992).

Moreover, making games requires that students not only learn the subject matter well enough to represent it in a final project, but also that they master the particular means of production used to create the product itself (Ching, 1999). Production means can include physical model making, scale-model drawing, or the creation of software via programming and/or multimedia authoring. Students who experience learning through doing come away with more than academic knowledge and model building or computer skills, because they achieve learning by creating. Further, these skills emerge from practices in which students plan, manage, monitor, revise, and reflect on their emerging products (Blumenfeld et. al., 1991).

Games, part of popular culture, represent a new literacy where educators can study and exercise the human mind in ways that may give deeper insight into human thinking and learning, as well as new ways to engage learners in deep and engaged learning (Gee, 2008). A related study on students' "mindful practices" in learning through designing software found that when asked to talk about their competencies with programming and planning, students were able to engage in fairly sophisticated discussions about these topics (Kafai, under revision). Additionally, research has demonstrated that structured activities support students' reflection on abstract, metacognitive properties, whereas science-learning experience can affect students' content learning (Ackerman, 1995; White & Frederiksen, 1998). One of the biggest contributions the study of making games can achieve is to illuminate ways in which learning works when it is working best for human beings. This is, in part, because making games externalizes the way in which the human mind thinks; also, making games often organizes learning in deep and effective ways (Gee, 2008).

When we think of games, we think of fun. When we think of learning, we think of work. Game-making based learning shows us this is wrong. Game-making based learning triggers deep learning that itself is part and parcel of the fun. It is what makes good games deep—deep within the psyche of the learners (Gee, 2008). By understanding how new technologies can encourage students to take responsibility for their own learning in a creative way, society may help produce a generation of people who seek out ways to learn (Collins & Halverson, 2009). Gee (2005) argued that games offer learning experiences that are more compelling and challenging than those provided in schools.

Learning in schools should become more "playful" or "game-like," reflecting the forms of learning that identify the characteristics of "good" games (Gee, 2005). Although many students are already contributing to digital media, most of these contributions or creations are produced via the making (Kafai & Peppler, 2007b) of actual games. Making games enhances students' experiences via creative collaboration with others.

The choice should be to ask students to reflect, not about skills or competencies in the abstract but on the different ways of knowing and doing. These would be exhibited by individuals with varying amounts of design expertise as they work in the design process (Ching, 1999), as applied to digital media in the context of learning via challenge and response and interaction. Interaction allows learners to see the consequences of their actions (Collins & Halverson, 2009). Along with others, it is my belief that by providing even more sophisticated dynamic interaction, digital media-based learning environments are likely to make education much more intriguing and engrossing.

CHAPTER THREE:

RESEARCH METHODOLOGY

Qualitative Research

Qualitative research is on the idea of exploring and understanding a social or human problem, where the researcher builds a complex, holistic picture by analyzing words, reporting detailed views of information, and conducting the study in a natural setting (Creswell, 1998). The qualitative research approach is used to gain insight into people's attitudes, behaviors, value systems, concerns, motivations, aspirations, culture, or lifestyles (Ereaut, 2007), and to inform positive understanding, information, communication, and research.

A qualitative method was chosen for this study for several reasons. First, qualitative research enabled me to understand the complexities of the digital media curriculum and the experiences of teachers and students within their classrooms. Qualitative researchers assume that social settings are unique, dynamic, and complex (Hatch & Barclay-McLaughlin, 2006), and they build abstractions, concepts, hypotheses, and theories from detailed observations (Glesne, 1998).

Second, I was able to illuminate the detailed experiences of teachers and students' interaction with digital media curriculum and present the teachers and students' status within this framework of observation. Students' conceptions of learning differ, according to Ellis and Goodyear (2010), who explained how they view these differences in a theoretically and carefully designed qualitative study. In the present study, understanding the students and teachers' interactions with digital technologies illustrated and helped define the impact of digital media education. Third, I wanted to provide people a broader and more objective perspective of digital media education. According to Miletta and Miletta (2008), qualitative inquiry steers clear of making prescriptions for specific action. Like art, qualitative accounts of the drama of teaching and learning can have a profound and unpredictable effect on human thought and action. It was my hope that this study would provide people the means for deep contemplation regarding the role of digital media education in modern education.

Research Method

Educational Connoisseurship and Criticism

This study was conducted using the method of educational connoisseurship and criticism research method. Eisner (1998) declared educational criticism and connoisseurship as a method of qualitative inquiry intended to improve education. The term *educational connoisseurship* is meant as the art of appreciation arising from expertise in the domain of education; *educational criticism* is the art of and vehicle for disclosure of judgments to a wider audience. Eisner stated, "Educational critics are interested not only in making vivid what learners have experienced, but in explaining its meanings….Connoisseurship is the awareness of qualities as a fundamental achievement"

(p. 95). The intent of this method matched the intent of my study. Focusing on digital media education was the central theme of my work. I wanted to learn what the digital age offers education and what educators can then bring from this interaction to make a positive impact on learning.

Educational criticism and connoisseurship inquiry differ as a "way of seeing" (Eisner, 1998, p. 67) and open up a dialogue regarding the artistry and qualities of various educational settings (Eisner, 2002). Rather than viewing teachers as technicians, Eisner (1998) showed them as improvisers, capable of engaging in and enacting a variety of strategies in and through time and situations. Eisner (1998) perceived teachers as creative problem solvers, able to initiate and enact personally meaningful learning experiences (Irwin & Reynolds, 2010). It is in these conceptions of teachers and learners that artistry resides (Smith, 2005). This method asserts educators and researchers should embrace artistry when they engage in educational connoisseurship and educational criticism.

Connoisseurship is the art of appreciation, and criticism is the art of measured disclosure (Eisner, 2002), as described earlier. By acquiring a range of experiences within classroom practices, an educational connoisseur is able to distinguish the difference between the significant and the insignificant. Eisner (1998) explained that educational connoisseurship as envisioned and applied to education is the "art of appreciation" (p. 63), drawing on the researchers' ability to differentiate between "subtle and complex qualities" (p. 63) of educational experience. The art of connoisseurship requires that the researchers have enough educational knowledge to be able to observe the subtleties and intricacies of the educational setting (Irwin & Reynolds, 2010). Connoisseurship is acquired through a range of experiences within a particular mode of expression. Geetz

(1973) indicated that connoisseurs perceive such particular situations and then use that knowledge to understand relationships within contexts. Ideally, these experiences are situated within a set of values and theoretical ideas that have the potential to influence perception.

Criticism takes the private act of connoisseurship and "illuminates, interprets and appraises the qualities that have been experienced" (Eisner, 1998, p. 86). For example, teachers who use educational criticism would help parents and/or other teachers understand what was learned and how it was learned. Criticism is the art of disclosure, because it gives the data to public audiences and, of course, the material is made available through a connoisseurship perspective, such as using images, film, photography, and/or performance to inform description (Irwin & Reynolds, 2010). The educational critic is charged with the task of separating the trivial from the significant and helping the readers understand what is important. Determining importance is the responsibility of educational connoisseurs and critics. The art of knowledgeable perception resides in personal sensory experiences and the memories we acquire from these sensory experiences.

Eisner (1998) asserted that qualitative forms of inquiry provide a framework for the critic that includes description, interpretation, evaluation, and thematics. These components represent and describe the richness and complexity found in teaching and learning situations. The underlying *description* is an "attempt to identify and characterize, portray, or render in language the relevant qualities of educational life" (Eisner, 2002, p. 226). Description enables readers to visualize a setting, and that is how critics try to help them understand the educational event. The critic does not write about everything happening in a situation, but rather focuses his/her attention and writes about what he/she chooses to attend to (Eisner, 2002). Description blends into the aspect of interpretation, because interpretation explains "the potential consequences of practices observed and provides reasons that account for what has been seen" (Eisner, 1998, p. 95).

The emphasis and focus of *interpretation* is applying ideas or theories that help the critic implement meaning and understand what he/she has observed. *Evaluation* themes judge the educational significance of description and interpretation. Evaluation supports the readers in making the choice between description and interpretative observation. And finally, *thematics* provides the readers with the larger lesson a criticism has to offer (Eisner, 1998). All themes offer a recurring message or summary that emerges from the criticism. The aim is to impart to the readers a distinct set of assumptions or guidance for understanding the educational setting.

Introduction to Research Design

In determining the potential of digital media education, I wanted to learn more about the use of digital media technology in existing classes and the classroom teachers' goals. I sought to learn the teachers' thoughts as they planned their students' experiences in digital media education. From these data, I was able to provide both myself and other educators who are interested in this field the current "state of the art" of digital media in education.

There was no empirical data publicly available as to how many middle schools in Denver offer a digital media technology class. In some schools, schools and principals have tried to increase the use of digital technologies, but there has not been a strongly defined curriculum and training for teachers. In some cases, students can use computers for typing papers, learning foreign languages, or preparing PowerPoint presentations—the basics. In other cases, teachers who have a greater degree of interest in digital technology are more willing to try to incorporate its use in the classroom.

In my research, the choice of study sites was more proactive than a study in which the school or classroom sites were chosen indiscriminately. My purposive selection of sites was strongly influenced by classrooms where the teachers had planned a solid curriculum to help students learn goals while using the context of digital media technology. Accordingly, I created selection criteria based on particular requirements of the digital teachers within those sites as follows: teachers who (a) guide students with a diverse use of digital media, (b) use Scratch™ as a learning application, and (c) implement a varied curriculum based on contemporary life. I used these criteria as my guide, because my study is meant to trigger a rethinking of digital media in education, and my research sought to learn from teachers' cohesive planning efforts for their digital technology class, seeing the experience through a game-making based learning project, such as Scratch. I was introduced to several digital technology teachers in the Denver area and had the opportunity to share my thoughts with them within a range of discussions. This resulted in my decision to study four teachers' classes in two suburban school districts: Mountain View and Green Valley Districts (pseudonyms for the actual districts, for confidentiality purposes). I believed these two different suburban districts would provide contrast useful for my research.

There are many devices or programs in the universe of digital media. In this study, I examined the use of the Scratch™ program in the 7th and 8th grade classes by studying both the teachers and students as well as their teaching and learning experience in the digital technology class. The Scratch™ program was chosen for this study as one of many examples of digital media in students' lives today because Scratch became the lens through which I examined this learning phenomenon.

Teachers in four classroom sites granted me access and permission to conduct my research, and the school directors approved my research questions and methodology of educational criticism and connoisseurship. I applied for formal approval from the districts before I was permitted to be a researcher at these sites.

Research Design and Data Collection

The collection of data in this study included observations, formal and informal interviews, and the collection of artifacts. For confidentiality purposes, pseudonyms were given to the schools, teachers, and students, as mentioned above. The four teachers were called Mr. Winter, Mr. Snow, Ms. Moore, and Ms. Wood. (See Table 1 for a summary of their teaching experience.) In this study, I spent approximately 1 hour per day over 4 to 7 weeks at each site in their computer classrooms.

Table 1

Summary of Teaching Experience of the Four Teachers

Teachers	School	Years of teaching experience	Years of teaching digital technology class experience
Mr. Snow	Apple	22 yrs.	6 yrs.
Mr. Winter	Apple	32 yrs.	6 yrs.
Ms. Moore	Happy Valley	19 yrs.	5 yrs.
Ms. Wood	Vista Height	17 yrs.	10 yrs.

I began with an informal introductory talk so students would not be surprised as to why I was sitting in their classroom. I also prepared a letter for students to take to their parents explaining the purpose of my study (see Appendix C). I was clear in assuring parents that my appearance in their children's digital technology classroom would not distract from the learning process.

Participants

Students' use of digital media and technology has been discussed in several studies, and a number of scholars have stated students usually have a certain level of fluency and capability with these devices. Thus, without consideration of gender or ethnicity, the specific population I examined in this study targeted 7^{th} and 8^{th} grade students as "digital kids." I wanted to learn more about students' approach to learning in a digital media technology class without bias or preconceived notions.

Each of the two classes in Mountain View District contained 30 students. In Green Valley District, one class had 15 students and the other class contained 22 students. The ages of these students ranged from 12 to 14. Participation in the formal interview was voluntary and based on the selected individuals' desire to share their experiences with me. My goal was to find students that were using these digital media technologies and expressed a level of comfort with their use. To this end, I asked for teachers' suggestions in ideally selecting 2 male and 2 female students in each class to participate in the formal interview process who were the most active and engaged students—students who were generally cooperative, communicative, and willing to participate in such a process, including those with good behavior suitable to the work.

Next, I asked these students if they were interested in becoming involved in my study. I also sent an introductory letter and consent form to their parents for their approval, as stated earlier. In this communication, I explained the purpose of the study, the general content of the interview procedures, and protective steps for their children to pause or stop the interview if needed, as well as confidentiality protocols. When permission was received, I provided each participant with a clear explanation of the study, including the interview content and process. I assured participants that their responses would not be shared with their parents, former or current teachers, or any peer students, nor have any impact on their classroom grade. Each participant also selected a pseudonym to protect his/her confidentiality.

Sources of Data Collection

Observation. In this study, the most important data source for educational connoisseurship was the observation of teachers, students, and classroom life (Eisner, 1998). As mentioned earlier, within each class, I spent 1 hour per day, over a total of 4 to 7 weeks, for the initial observation of the teachers and their students. Over this same period of time, I sat in the rear of the classrooms, strictly for observation. During the general observation phase of my work, I did not interact in any way with the classroom teaching and learning. Students were encouraged to come and talk with me after class to share their thoughts and processes or ask any questions, without any influence or bearing on their work in school. My primary function was to observe and record the experience of the teachers and students in the classrooms and their interactions with each other, the digital media curriculum, and the digital technology environment.

The interview. Interviewing is a mode of inquiry that allows the researcher to understand the experience of other people and the meaning they take away from the experience discussed (Seidman, 1998). Moreover, one of the primary goals of qualitative researchers is to capture the insider perspective, and interviewing is one way to achieve this (Hatch & Barclay-McLaughlin, 2006). Eisner (1998) contended the interview is a powerful way to understand how people perceive situations in which they work. Accordingly, I conducted both formal and informal interviews in person at the sites.

Formal interviews were conducted with the teacher and four participating students at each site, when they had almost finished a specific project. The aim of the formal interview was to listen to and understand their personal voices as they expressed their relationships with a digital media project. I chose to conduct the formal interview the week when the project was completed so the individuals might be more objective versus when they were immersed in the task at hand.

From the four classes of students, altogether 16 participating students were scheduled for formal interviews, as scheduling by their teachers permitted. Individual interviews were conducted at sites suggested by the interviewees or their teachers in order to shift the balance of power toward the participants (Faux, Walsh, & Deatrick, 1988). I coordinated "in-class/school" locations with the teachers and schools to achieve a greater amount of impartiality and remove my outside influence from the process.

I interviewed the teachers based on their schedule after they had completed a specific project. I communicated with the teachers as to a proper time and location also. The teachers were busy and most likely preparing for their next project, and I did not occupy too much of their time. Usually, I conducted interviews with the teachers in their classroom at the end of class.

In this study, I was the data-gathering instrument. When conducting a formal interview, I used a semi-structured interview protocol with open-ended questions. Two interview guides were used during the interview process and each session—one for the teachers and one for the students (see Appendices A and B), respectively. The follow-up questions depended on the answers that each interviewee provided. With permission of the participants, I recorded the interviews for my future reference.

The interviews were transcribed in accordance with Yow's (2005) suggestion to stay as close to the sounds on the recorder as possible, including poor grammar; slang; vernacular; pause; "crutch" (Yow, 2005, p. 317) words, such as "um," "well," and "you know"; and false stops and starts (Bass, 2009). These increased my challenge working with the data, but it provided indications of deeper meanings in the response. To capture one person's story without his or her expression, personality, and nuance would offer only bland and obscure information. The most significant strategy for establishing credibility is the use of such elements of communication. I pursued natural and unaltered responses, allowing me to understand the teachers and students in their natural environment.

Students' reactions to their classroom experience were usually gathered through their comments and conversations before, during, and after class (Schofield, 1995). Thus, informal interviews included casual conversations with students, as well as teachers and other school personnel. The use of e-mail correspondence with teachers was used as a supplement and for clarification of any elements of their process and/or the results I gathered. In collating and reporting these communications, I upheld strict confidentiality of the participants by using pseudonyms to protect their identity, as indicated earlier.

Artifacts. The purpose of connoisseurship is to understand what is happening, so any data source that can help make sense of the situation is an appropriate resource (Eisner, 1998). The gathering of artifacts was another useful instrument in data collection. I collected materials from each school, such as brochures, lesson plans, informational booklets, curriculum guidelines, newsletters, photocopies of the students' work, and other items that I deemed beneficial. With student, school, and parental permission, I took photographs while working in each classroom to catalogue the environment and work.

Journal. I kept a reflective personal journal as part of my research. In this journal, I wrote my own impressions as they arose during the research. In general, this strategy offers the researcher time to list and then reflect on what he/she has observed and may then inspire new questions or points of reflection to use as the observation continues. This form of spontaneous writing kept me engaged with the study and helped make connections between the observation and relevant theories that were then used to make useful interpretations of the data (Trousas, 2009).

Data Analysis

Educational criticism assumes that multiple realities exist, and the researcher is portraying only one, with the researcher's interpretation at the center of the analytical procedures (Hatch, 2002). According to Rubin and Rubin (2005), data analysis should occur throughout the interview process and should seek to discover variation, portray nuance in meaning, and examine complexity. Furthermore, it should rely on transcriptions versus memory or intuition (Bass, 2009). Altogether, the data analysis process was deductive—from the specifics I gathered to generalizations of the environment, responses, and other data.

First, I typed my field notes on a daily basis to organize my experience and reflected on the material encountered that day. Upon review, I added any information that

I might have missed during note taking. Second, I personally transcribed all interviews, which again re-organized my thoughts with these experiences. By examining my field notes, I sought indicators of codes and patterns in events and behavior and subsequently accounted for them in an evolving document. Creswell (1998) recommended starting with a short list of tentative codes to categorize the data—5 to 6 codes—then, when reviewing the re-reviewed data, expanding that number to no more than 25 to 30 codes, and in the end, reducing that number to roughly 5 or 6 codes when writing the narrative. When I was confident with the thoroughness of my data collection and had applied a decoding of the research process to the final evaluation, I was satisfied with the process.

Striving to reduce the potential for subjectivity in my involvement, I used the poetic representation strategy that Mears (2005) used in her dissertation, *Experience of Columbine Parents: Finding a Way to Tomorrow*. According to Mears, "Analyzing volumes of interview transcripts and reducing that data into a meaningful and manageable form is a challenging task" (p. 66). The intent is to share the learning experience and that requires more than a purely context-based accounting of what takes place in the interviews. With this in mind, I believed the poetic representation description strategy for students' interviews would more contextually and vividly display their learning experiences with digital technology.

After transcribing each of the students' interviews, I went back to read and mark significant passages that connected their experiences and reflection. I carefully chose their own essential words to communicate individual students' messages. I then linked and re-linked again into a cohesive passage. As an outcome in this process, for each student, I provided a poetic representation of his or her comments and interview that would offer readers a chance to hear their voice.

Finally, I used Eisner's (1998) educational connoisseurship and criticism as my guide to the conceptual framework of learning in data analysis. As discussed earlier, the four dimensions of educational criticism are the description, interpretation, evaluation, and thematics (Eisner, 1998). Using educational connoisseurship to analyze my data allowed access to the complex and subtle aspects of teaching and learning, whereas educational criticism helped reconstruct the qualities through which perception was increased and understanding was deepened (Bass, 2009). The conceptual framework from Eisner assisted me in exploring the elements of multifaceted thinking, motivation, engagement, experience, and creativity that I had set as the goals in my study. As I analyzed the data, I sought a deeper significance as they related to the participants' experiences and the rules or theories that gave them order (Bass, 2009; Eisner, 2002) and guided the questions I raised for this study. I consistently retained an open mind to the data that did not seem to fit within this framework to make sure that I did not miss items of any potential significance.

Combined these strategies steered my data analysis, while allowing for data to emerge from my interaction within the setting and with the participants. Because the qualitative researcher seeks to understand the perspectives of the participants (Hatch, 2002), I sought and selected thematic categories that contributed a structure for the interpretation of the described educational experiences.

Validity

Educational critics provide two ways to support the validity of their studies. First is the strategy of structured corroboration, such as the process of triangulation, as a means through which multiple types of data that are related to each other are used to either support or contradict the validity of one's findings (Eisner, 1998). These data normally come from direct observations of the setting, interviews, and the analysis of artifacts. Educational critics seek the convergence of evidence that establishes credibility and allows the researcher to feel confident about his/her observations, interpretations, and conclusion.

Referential adequacy is the second strategy. Eisner (1998) explained that "an educational critic's work is referentially adequate when readers are able to see what they would have missed without the critics' observation" (p. 114). Educational criticism may be used to support the validity of the researcher's statements in regard to seeking referential adequacy (Eisner, 1998). An educational criticism is referentially adequate to the extent that its audience is able to locate the descriptions, interpretations, evaluations, and thematics that the educational critic has addressed in his or her study (Trousas, 2009).

Educational criticism also seeks to understand the setting in a manner that reveals the way it actually is and not what he or she—the observer/researcher with personal bias—wishes it to be (Trousas, 2009). It is not easy to avoid bias. My background as a designer-artist and educator, who is devoted to digital technology but new to middle school teaching and the Scratch program, suggested the possibility of altering the view or perspective of the study. However, the connoisseur's spirit as well as my experiences, concerns, and biases were also seen as strengths to render to whoever might read the study an honest story of what is learned. My mission was to interpret what was seen and perceived, and subsequently use the techniques of the educational critic to deliver an understanding that represented a complete account of the process.

About the Researcher

Qualitative research assumes the researcher to be an integral part of the research process. Because educational connoisseurship and criticism lead the depiction and evaluation process, the value of the researcher him/herself is the link to the study in guiding the readers to the significance of the data. The researcher cannot separate him/herself from the topic or people being studied. It is in the interaction between the researcher and the researched that the knowledge is created (Mehra, 2002). My task as the researcher evoked my concerns in the field and showed where the topic was cogently developed or undeveloped.

In this study, I applied my own personal evolution as my perspective, because it was this process of learning, exploring, and applying information that drew me to this point. As a child in Taiwan, I always dreamed of being an artist, although my family, teachers, and even my friends encouraged me to pursue more economically viable professions. When I came to the United States, I chose to study graphic and interactive communication and minor in photography. With my interest in design and experience with computers from my previous work in engineering, graphic and interactive communication seemed a natural fit for me.

Being a designer-artist in this century and continually being aware of other cultures in this world, I was concerned with the development of my own aesthetic. With this in mind, I attended the art department at Kansas State University and majored in visual communication. During my advanced master's degree studies, I saw my creativities, talents, and design skills blossom and mature. When I received my Master of Fine Arts (MFA) and joined the art department at Kansas State University, I was allowed to let my interest and skills flourish, because I was in charge of the new media art program and developed its curriculum.

Moving to Denver and doing volunteer work as the educational director for the American Institute of Graphic Arts, Colorado chapter, I was inspired to think deeply about the possibilities of bringing design and design thinking to high school students and develop a motion graphic program for college students in a meaningful and sustainable way. Students would benefit from the integration of various disciplines to fuel the expansion of their processes towards creative thinking, evolving into the very core techniques that students cultivate in these early, formative years. Thus, students would enjoy opportunities to explore new media and motion graphic techniques, as they became full participants in modern society. However, several designers did not understand why I felt so strongly about new media art and motion graphic programs as a form of presentation. My answer was simple: I believe these digital technologies are fully integrated into modern life, because they are a form of expression, learning, and communication. With this in mind, I chose to continue my studies in the doctoral program at the University of Denver.

In Taiwan, I learned that an artist must be strong enough to pursue his/her vision even when others may challenge it. In my undergraduate degree studies, I learned much about art and design and becoming a designer-artist. At work, I learned how to endeavor for a company and cooperate with other people. In my master's degree studies, I explored new directions and possibilities with professional expertise and achieved a balance in aesthetics and modern life. I believe that "balance" is where we can use the tools in the context of modern aesthetic theory, for example, examining the world from a diverse range of connections, active engagement, sensory experience, perceptivity, risk taking and imagination (Uhrmacher 2009), making and receiving compromise from the constraints and definitions of contemporary living, such as work, finance, and other socioeconomic barriers and obligations. While teaching graphic and visual communication, I assisted students with not only professional skills but also how thinking differently heightens the quality of their academic and professional work.

These experiences have had a positive impact on my personal growth. My own educational, teaching, and professional experiences have made me keenly aware of the significant discrepancies amongst various educational institutions and the desperate need for higher educational and teaching standards within both the educational and professional spheres. I have developed a deeper interest in research, in learning how to advance more effective educational programs, and in teaching curricula for art, design, visual communication, and digital media. These should incorporate not only the required fundamental skills, but also the educational skills and factors motivating both teachers and students to advance learning and expand their creative processes.

CHAPTER FOUR:

DESCRIPTIONS AND INTERPRETATION OF

THE PARTICIPANTS AND THEIR CLASSROOM

Introduction

My research took place in four classrooms that I observed and where I interviewed the participating teachers and students in order to acquire detailed, authentic representations of their work and personal insights in this field. In order to depict what was happening in each of the classes, I have included vignettes from my time in each classroom as well as data from students and teachers' interviews. In this study, I attempted to provide detailed descriptions from my approach to and observation of the classes, teachers, and students in a positive and respectful manner.

This study was developed from the qualitative methodology of educational connoisseurship and criticism, which is comprised of the components of *description, interpretation, evaluation,* and *thematics* (Eisner, 1998). I have sought to contribute compelling descriptions and highly attentive interpretations for the readers in this chapter. In the next chapter, I provide readers with the evaluation and thematic analysis of my observation.

Descriptions of each of the classrooms are organized into six areas: the classroom experience, the teacher's approach, engagement, creativity, students' responses, and observations of behind the scenes. These areas were selected based on my careful examination of the data and serve to promote further discussion regarding the components of the teachers and students' experience in teaching and learning in a digital media technology class. Such organization has also allowed for deeper discussion of chosen conceptual frameworks of multifaceted thinking, motivation, engagement, experience, and creativity.

The Classroom Experience

The classroom experience includes the teachers and students' experience and interactions on a day-to-day basis. The students' learning experience reflects the teachers' beliefs and operation of the class itself, and is directly related to how the teacher interacts, instructs, and imparts information to the students in the classroom. The processes and environment used by the teacher become evident in the responses to input by students. An individual learner's action in the classroom is founded on his or her belief, intention, and interaction with the teacher, peers, and class. More specifically, the aim of this research is to learn about the teaching and learning experience and is concerned with the students' interaction with the teacher's methodology and strategy and the students' reaction.

For my data collection, I focused on the interaction of the teachers and students to further understand students' learning and teachers' teaching of a specific game-making program in the context of the technology class and their teaching and learning experience. I was especially interested in how students interact with the digital technology environment. I provided a detailed description of the data, based on the teachers and students' beliefs, examination, interaction, and actual operations in the functioning of the class and use of the tools at hand. I also offered an interpretive analysis of these operations to help explain the meaning of the final description of the students' work, including both the work product and the processes they used, with both my own and the teachers' interpretation of the data to explain these descriptions.

The Teacher's Approach

Teachers are pivotal in their enhancement of the whole learning experience. The description of the teachers' approach is comprised of their beliefs, intention, curriculum design, and operations related to their personal qualities as a professional educator.

I first considered learning more about the teachers' curriculum design for their class, their philosophy of education, and their motivation for teaching the digital technology and game-making program. I employed the teachers' thoughts and interpretation of the data to explain these descriptions.

My research focused on the intent of the teachers in teaching a digital technology class and how that intent suggested to them a game-making program like Scratch as a useful tool. It is important to note my study is not focused on the actual game making; it is more about students' learning experience from the perspective of using a game-making program and about their development as seen from the examination of this use of games. Moreover, I was interested in how the teachers designed the curriculum to assist students to learn in the field chosen to teach. For example, was the curriculum chosen based on student interest, an administrative decision, a teacher's preference, or was it society and/or environment driven? I was also curious how the teachers advanced the curriculum, letting it evolve under their experience and guidance to become a more mature device for education. I also paid attention to whether or not the curriculum engaged the students, how the teacher personally engaged students with the present curriculum, and so forth.

Engagement

Engagement is a form of participation that suggests students keep learning, are actively involved in the classroom, and dynamically contribute to the effort at hand. This form of participation is examined in detail by considering three primary elements. The first one is involvement. The students' participation in learning actively in class activities was vital to their actual learning. Further, it is important to consider the students' reaction to the sum of the tasks required and observe how consistent their quality of work was from start to finish. The second element is effort. Did this technology class spark students' desire to learn and motivate them to learn more? The final element is the students' response. I was interested to learn how students interacted and reacted with their teacher, peers, and the class as a whole in this context.

I used several techniques to observe how engagement is fostered and then manifests itself in the work product of students. In order to provide a good description of engagement, I sought to learn how the use of digital media technology creates and sustains active involvement between the subject and the learners. Did the teachers' desire to provide a safe environment encourage students' active engagement? Did the digital atmosphere increase students' comfort levels? I looked at the classroom environment, including mentors and other forms of coaching, because this was also critical in fostering students' engagement. I wanted to know at what levels these factors came into play when examining the use of digital media. I was also interested to learn if students' emotions, when applied to and derived from digital technology, were a key motivation for their engagement.

Creativity

The development and promotion of creativity in the classroom is a crucial topic. Establishing a fertile environment to encourage a creative mind is invaluable in today's society. Scholars have suggested that the rapid growth of digital technology may have contributed creative thinking in some aspects of peoples' lives. If used properly, there is the potential to help users develop creative thinking to sustain a better life in such a society in the 21st century.

In the digital technology class, the teachers instructed students on the operation of the software and hardware and encouraged them to think differently while working with the technology to create a unique and high quality final project. Students interacted with each other and shared with friends their plans for the games they created. Students talked about process as well as the final project. The teachers provided an effective environment for students to try out whatever they wanted to do. This was both conducive to their work and a satisfying experience for the learners. The teachers encouraged students to own their individual ideas, taking pride that they had created the final project with their own hands. The point of the project was to enable students to think for themselves, a trait that would be important in the future. The increased use of digital technology might help develop students' ability for multifaceted thinking. The increased use of digital technology is a learning process where they try it out, test the boundaries, experiment with alternatives, get input from others, and generate new ideas based on their experience.

In this study, I sought to learn how the students' approach to the digital media technology learning environment would enhance their thinking and develop in them a creative mind. Can digital media technology intensify students' creativity? Can this approach result in a more interesting final project and greater learning? Does digital media technology expand students' creativity to fit with contemporary life?

Behind the Scenes

To gain a better understanding of the students' learning experience, it is mandatory to view the influential events outside the formal classroom setting. My research focused on students' learning in the digital technology class and the game-making project. Digital technology use and learning are not limited to one program in one classroom, however. Students have explored their use of digital media technology in virtually all facets of their lives. During my observations in these classes, I noticed students' diverse opinions of and skills in the use of digital technology. With this in mind, I extended my data description behind the scenes of the regular classroom happenings.

Again, this study focused on what effect teaching digital media technology has in the classroom on both teachers and students. The specific technology used in this study was Scratch. Scratch, designed by the MIT Media Lab, is an educational programming language that allows people of any level of experience and age to experiment with a fully versatile digital media environment. Explained below are some technical words used in Scratch:

- *Sprite* is the object that performs actions in a Scratch project. Several teachers also referred to it as "character." There is at least one sprite in each project.
- *Scripting* is code programming in Scratch. Users can give instructions to a sprite by snapping together blocks in the scripting area.
- *Blocks* are puzzle-shaped pieces that are used to create coding in Scratch. The blocks connect to each other like a puzzle for a sequence of action.

Mr. Snow, Technology Teacher

Mr. Snow is a technology teacher at Apple Middle School, a high-performing public middle school in the Mountain View District in Denver, Colorado that serves students who speak some 70 different native languages. Mr. Snow started his teaching career in a preschool in 1990 and joined Apple Middle School 13 years ago as a reading teacher. Because of Mr. Snow's interest in technology, he chose to study curriculum design with a computer focus as his master's degree program. He became highly qualified in this field, and it was suggested to him that he take a job as a technology teacher. It is his 6th year teaching a computer and technology course.

Mr. Snow is in his mid 40s, White, and married with four sons. Mr. Snow talks about his family frequently and creates an atmosphere of "we are all family" with his students. Every day he brings a bright smile to the classroom, trying to set the visual tone of the classroom, which contrasts with his dark-colored hair and masculine body figure, and makes his students feel comfortable approaching him. Mr. Snow teaches two forms of technology classes. One is an elective class, which students can choose from among the five elective classes offered each semester: art, music, drama, physical exercise, and technology. The other is an Access[18] class. Students have to have high GPAs to be qualified to join this class. Students in this class focus on making video games with the Scratch and GreenFoot[19] programs. Students learned to use Scratch and then made three Scratch games during this period. I observed Mr. Snow and his Access class 45 minutes every week day in September and October 2011. I occasionally continued to sit in on the class after this period, at which time I interviewed Mr. Snow and the four chosen students in November 2011.

The 30 students in this class represented an ethnically diverse group, with White, Hispanic, African American, Asian, and Muslim students. However, there were only three girls in the class. The following descriptions of Mr. Snow and his class are organized into six sections: the classroom experience, the teacher's approach, engagement, creativity, students' response, and observations from behind the scenes. Together, these provide an in-depth depiction of how teaching and learning is done in this technology class at a middle school in suburban Denver, Colorado.

The Classroom Experience

"Mr. Snow, I need help!"

"Mr. Snow, How do I make the characters walk to the next screen?"

It was a sunny day in the late summer. Students walked into the classroom with an easy disposition, wearing t-shirts and carrying their work folder and a flash drive. The flash drive is a requirement for this class, so students can easily transfer their work from a

---

[18] This is the name used by the District for this class.

[19] Greenfoot is a free Java programming environment software. Students learn about Java language while building two-dimensional interactive games (Greenfoot, 2012).

school computer to a home computer or keep files for their own use. I observed some students chained their flash drive to their student I.D. so it would not be lost—a clear sign of its importance. From the conversations I had with several students, although they did not feel an obligation to do extra work at home, they enjoyed working on their games whenever and wherever they wanted.

In Apple Middle School, there is a group of students working on the school news production, the Apple News Network (ANN), which follows students on the school television system. It is shown to the teachers, faculty, and students every morning. Because Mr. Snow's Access class is the first class of the day, students and the teacher share this experience together every morning. I felt lucky to participate in this activity to learn more about the school's activities. Some students brought breakfast and ate together at a table in the center of the classroom during the ANN news. Most students turned on the computer immediately when they walked into the classroom. The students either started working on their game or waited to ask Mr. Snow questions when ANN ended.

This class is designed to teach students to make video games. However, it is not only about making games. This class is also about what students can take from the process and content of making games. Mr. Snow commented about making games for learning:

> Working on making a game, I really hope students do not only think about how they can make a game. I want them to think a game is like from point A to Z. How do I get to there? So I need an objective and should be able to explain the objective and instructions clearly. Otherwise, the player is not going to play it. When I think about A, B, and C, the player might only want 1, 2, or 3. So how can I communicate through this medium with this person who does not think the same way I think? What can I do in order to make sure they can understand the objective I emphasize in this game? These are very important communication and logical thinking skills. The objective could be simple, as if you are waiting for the

> snow to melt and go through a cave, or it could be as complex as a maze. You might need to answer several complicated questions and deal with a dragon. But it doesn't matter. The point is you need to go from point A to point Z and that the player understands it and has fun.

In daily life, we use our communication skills when we write with pen and paper, talk with somebody, or simply create an e-mail as is so common today. But when we have the opportunity to make a game, we have very little opportunity to get feedback from the player. This is a problem also seen within the constraints of the classroom time allocated to these tasks. The feedback may simply be if people like to play the game or not, or if they can understand the objective and instructions to continue playing the game with enjoyment. This method of the game creator, in striving to engage the player of the game, involves information and responding to the player's feedback. As a result, students gained great value in learning while making a game. While discussing the value of learning in making a game, Mr. Snow emphasizes "logical thinking." Albrecht (1984), in his book, *Brain Building*, defined logical thinking as a process in which one consistently uses reason to come to a conclusion by establishing an understanding relationship between the problems and the facts. This is echoed in the learning from logical thinking used when a student learns to make a game. The student needs to build several statements within the game, from beginning to end, that are founded on the feedback that they get from their peers, teachers, and logic, so the player will experience joy while playing.

The storyboard is also a required assignment before a student is ready to make a game on the computer. Basically students need to show Mr. Snow the characters (sprites) used, backgrounds applied in different scenes, and the operations required to keep the game going. For example, how does the player use certain keys to play the game; should he/she use the space bar or wait a few seconds for the next activity? Several students shared their thoughts about the storyboard process with me: “I think storyboard is boring”; “I did it because Mr. Snow asked for it”; and “I think all these things in my brain; why do I need to prepare this storyboard assignment?” Mr. Snow explained to the students:

> When you make a project, the key is you need to have a plan. Just like building a house, if you want a better house, you need to plan what kind of house, how tall will the house be, and so on.

The process is similar in making a game: Decide what you want to do to start at point A and figure out how you get yourself and other players to point Z. What should the players do between points A and Z, or how do they get back to the beginning of the game? How does the game maker make the backgrounds; how does he/she make the characters work with the background? In order to do it well, the game maker needs to have a plan before he/she is ready to start building the parts. Without planning, students would discover, “Hey, I put all this work into it, how come my game is not working?” Then the game maker would get very bad feedback internally and from the players.

This is what Mr. Snow highlighted in the process of using logical thinking while planning and learning to make a game: The plan for making a game is a highly sequential process. If the students did not comprehend the concepts, procedure, or operational and programming facts in the process of making a game, they would not achieve the reward of making a game that played satisfactorily. Generally, adults think about the plan before and during their work on a project. Young students show a clear tendency to want to immediately work on the computer, without thinking about a plan or the sequence of the actual process. Mr. Snow noted,

> There is nothing wrong in wanting to throw things all together and see what happens. But if we help students to understand the fundamental elements of the task, and their function, it is good we start to train them to work on a storyboard as a plan. I do not judge if it is a good drawing with a clear description or not, as long as they start learning to work on a plan.

Here it is evident that Mr. Snow focuses on process versus content as a key component of learning.

Making a game requires a certain level of math knowledge. Mr. Snow commented,

> Most students do not recognize it [the application of math]. Some students understand the use of x and y coordinates and plots to keep the sprites on the stage. But if I want to stress the math used for coding to make their game more interesting, some of them would get scared. It costs the fun of making a game. In this stage, I can only show them the logical reasoning and basic math use. Once they explore more, they would have fun to make a more complicated game with a higher-level use of math.

Regarding this discussion, one student spoke with me about her understanding of math use in making a game,

> I understand we have used math while making a game, at least the x and y location use. In some games, I need to use some words like "if," "if not," or "forever" for building the coding, I understand they are mathematical languages.

Several scholars have stressed playing games to enhance logical thinking and as a new way to learn math (Baek, Kim, Yun, & Cheong, 2008). Games are often characterized as an approach to overcome challenges and support the development of problem solving. Math is certainly an integral part of playing, because it involves logical thinking and problem solving. While making a game, students practice logical thinking and the use of what they already know in their math knowledge to plan a game in their mind and connect the game designer and player within the game itself. In the process, they practice math and logical thinking without conscious notice. One student said to me,

> I prefer not to hear about the word "math" while making a game. I know that it is all math concepts while figuring out the coding, and it is not too hard. It is more interesting here than in the math class. Listening to the word math scares me.

Students usually do not have a problem thinking up a topic for the game they want to make. Basically, the topic they choose is whatever they are interested in at that point in time. During one class period, I observed students usually browsed on the Scratch website, provided by MIT at http://www.scratch.mit.edu to view other people's work and then decided what kind of game they wanted to create. Some students shared their thoughts with Mr. Snow, but others wanted to start working immediately on their own. In this case, Mr. Snow required students to prepare a storyboard and write a simple paragraph about the kind of game they wanted to do and submit it to him—from their online folder to his folder on the classroom network.

According to Mr. Snow, most students in this class, maybe 27 out of 30 students, are comfortable with the computer. Some students have been in his or another technology teacher's elective class before, so they have attained the basics of Scratch. There were also two students who learned Scratch in summer camp before this class. There were probably three students who felt comfortable with programming strategy. Most students, while not experts, were strong in technology use. Many liked to search on the Internet. They searched for whatever they wanted to learn about, ranging from their schoolwork to a pair of tennis shoes. Some students talked about how they have a social media account, such as Facebook, but do not use it often. Mr. Snow observed that some students see the computer as a great tool to attain a higher quality product in school. For example, they can use Microsoft Office for typing a paper or creating a PowerPoint presentation.

However, in general class discussions as well as in their interviews, most expressed that they see it as a fun toy or social thing, such as Internet searching and playing games.

At the beginning of the 6-week class, many students were normally excited: “Yes! I am going to make a game.” Others looked at Scratch and worried if it would be hard. Students generally wanted to try new things and become different, making their work a unique representation of themselves and their ideas (Delpit, 1995). At this age, students need and want their own identity as individuals. They need that individuality to be shown in their work. Although the students I observed collaborated with each other and actively sought Mr. Snow’s input and guidance, they were all strong individuals with clear and concise expressions of their unique personalities, learning levels, and interests. Again, according to Mr. Snow, these students have a higher than average GPA and know they are here to learn to make games. These students are ready to take up this challenge. Since the first day of class, students showed their willpower and patience to learn how to make games. It is a challenge they wanted to master.

I also observed that these students have diverse interests regarding computer use, topic, and content for their games; the art they use; and many more elements that display their broad interests. During individual class time and over the course of my observation, I was surprised by the change in their perspective and overall improvement in using Scratch through the entire process, from storyboard to completion. They displayed real advances in making games, conversations with each other, or/and their eagerness to make more complex games. One student explained, “It is because of imagination. Students are filled with imagination and that is why we can do it!” This student’s mother always used this concept to encourage him to keep working hard. This is also reflected in Mr. Snow's viewpoint: "When students want to explore, that is how they learn."

Mr. Snow's teaching strategy is "tell, show, and let them go." Tell them a little bit, show them a little bit, then let them explore. Later, bring them back and tell them, show them, and they explore on their own. Students usually get bored during the lectures (Allen, 1986). When learning to make a game, students should be allowed to test the process and game's possibilities on their own. However, the necessary discipline of the classroom environment helps students stay in the focus and context of the curriculum used. During the learning process, students frequently have questions, keeping Mr. Snow very busy.

By the time students were working on their third game, they seemed to be more comfortable with Scratch. I noticed students were very quiet and looked more intently into their work as their fluency with Scratch increased. Sometimes, the quiet could make one wonder if an exam were taking place. Occasionally, some students found questions to discuss with Mr. Snow. If a student struggled with the best way to solve a problem, Mr. Snow would go over and look through the coding with the student, then cheer him/her on with a smile: "It is just a little bit more thinking; you can do it."

"Think of all the possibilities," Mr. Snow urged, and went on to explain, "The famous scientist, Thomas Edison, tried 1,016 times before he invented the light bulb. He said that he used 1,016 times to prove what was not working." Mr. Snow used Edison as an example to encourage students to explore whatever is in their minds and keep focused on their work at all times. Also, he reminded students, "If whatever elements you tested were not working, set them aside, you might find them useful later." Mr. Snow also emphasizes he does not keep students in a defined box of thinking, solving, and developing definitions, so they can explore in their own way. Some students might come back to the box of definitions set in Scratch or other tools, but others might stay outside the box and create new and often unanticipated ways to work in this fashion.

According to Mr. Snow, coding is surely a challenge for students. Figuring out coding is what Mr. Snow emphasizes as logical thinking. Coding is like a conversation with the computer, and the computer needs to get more clues from the coder to continue further actions—for example, the use of the Boolean statements “if” and “if not.” Mr. Snow pointed out, “We want to think positive, but often the need to use a ‘negative’ statement is very important in programming.” That is the conversation with the computer and the evidence of logical thinking. For example, many people play games but do not get the chance to think about “variables” within the planning, programming, and playing of a game. Most of time, the game makers need to think about “next” as an action for the characters based on the story, backgrounds, direction, and so on. In many games, students plan the game to move from one scene to the next. Most of them forget to indicate the statement “if not” to create another possibility. Mr. Snow hoped students would think deeper once they explore further.

While programming, students first meet the challenges in front of them, though they might stop from time to time and do something else or talk with friends and the teacher. By mingling, students may learn something they did not expect to learn. Mr. Snow commented, “As a teacher, I need to understand that I cannot be sure students focus on their efforts 100%. But when students play around a little bit, it does not mean they are not learning. Sometimes, noisy can be educational.” Students do not necessarily have to follow the path asked of them by the teacher. Students can find a sidetrack, and sometimes that is how a great discovery is made, showing the way to learn. Educators have to allow it. In Mr. Snow's class, students are encouraged to take a break from the difficulty at hand and look around for the best tools for their use. When they come back, they might ask, "I found these new tools; how I can get them here?" Mr. Snow hopes students, whoever and wherever they are, when they come back from whatever they were doing, can use the effort of what they found on their own and from the use of their experience. Mr. Snow continued, "If you force students, they will not learn."

Sometimes, when Mr. Snow showed something to one student, other students would come over to watch. There were many times when students would get together and play games while simultaneously having a discussion. These students are using peer exposure. They learn, collaborate with each other, exchange, and share with each other. Some students became good friends because of these game-playing and discussion activities, according to Mr. Snow's observation. Upon closer scrutiny, these students' games showed similarities and some influences from one to the other. Supporting this observation, students could be heard making such comments as,

"How did you do it?"

"I like what you did to keep the character flying when you click the space bar!"

"I made this game to help my younger brother to count."

"Ok. I fixed it. Do you want to play it again?"

Every so often, students' questions reflected their just wanting to extend the length of the class. Mr. Snow did not have as much time to respond to these students as he might have liked. Consequently some of them would come back to talk with him after school; others would try to explore on their own at home. There are generally several students working on their games at home. Mr. Snow mentioned that parents once complained that their boy had too much homework from him. In actuality, Mr. Snow does not like to give students homework, especially during the holidays. Students usually have enough time to work in school on their project. If there is any student working at home, it is simply because he/she wants to learn more and is actively motivated, according to Mr. Snow. There is no educator who would deny hard-working and engaged students. Some students just like to explore on their own or they simply prefer to work at home. Once, a student came to Mr. Snow and asked a question. Mr. Snow responded with a few thoughts while this student listened quietly. Then the student said, “Don’t tell me too much; I think I know something. I want to figure it out on my own.”

Mr. Snow provided this perspective on students’ involvement in the game-making process:

> These students are their own teacher. I am their facilitator. Making a game is not only cutting out pieces and sticking them together to make them move across the screen. There is a lot that goes into it: the programming, the interaction, the objects on the screen, the color on the screen, and working with other characters is a big eye opener for the students. There is consideration and thinking involved. When I am most proud of them is when they started picking up on these facts of the game, and some of them take those details and information and expanded on it and really get into it, focus on it, and learn it. That is amazing to me. They came here and focus on their work. They really get their hands dirty and get into it.

I understand Mr. Snow’s comment that it is obvious that a number of these students really want to learn more about technology and making games. Some of them have learned the relationships between the blocks for coding and are conscious of how they work together. They have understood the transition from those different blocks to actual codes. Mr.

Snow believes that, sometimes, the coding was frustrating for them, but properly channeled, the frustration could be good, because it shows the interrelationship of students wanting to learn and trying hard.

Classroom Environment

Mr. Snow keeps his classroom in a very organized and professional looking environment, well-suited for computer use. There are 25 computers sitting side by side on four sides of the classroom, and 9 computers are located in the middle. The school upgrades their computers every 2 years, with the newest computers in the classroom being from the year 2009. There are still three eMac computers from 2004 in the classroom as well. All computers are Apple products. Mr. Snow commented that it is good to teach students about older computers and their systems, but he prefers to keep a unified curriculum and use the newest machines, because there is a real inconvenience when the older machines do not have software that follows the current curriculum. In this era of constantly changing technology, it is best to keep students working within the most up-to-date technology environment possible. Students learn to fit and work inside the demands of society; they grow up with these technologies and use them daily without consciousness and feel comfortable operating their tools everywhere (Prensky, 2001).

Mr. Snow sets his desk by the left side of the classroom against two other desks, with three computers for students' use when they are working with him on a particular task. There is a 25-inch PowerMac and scanner on his desk. Mr. Snow does not keep much other material on the desk besides paper to track student attendance. There is a projector hung on the west-side wall, and most students can view it from their chairs without rotating. Mr. Snow occasionally uses the projector for instruction. Also, there is one TV hanging from the ceiling, but the class uses the one standing by the front door for the ANN news every morning, and there is also a printer by the front door.

On the wall, Mr. Snow has several posters about the technology being taught and its resulting knowledge, with some of these posters published by the Apple computer company. There are two posters with the bold headline, “Rethink.” One of these immediately stands out, because it has upside-down, rainbow-colored words on a black background, with the sub-headline “Think all possibilities.” Mr. Snow said some students have told him, “Mr. Snow, it is upside down.” But Mr. Snow uses it to show students the profound meaning behind “rethink” when doing their work. Evidently, that is the message Mr. Snow wants to constantly convey to his students: Rethink all possibilities. Mr. Snow sets up his classroom reflecting his personality, which includes enjoying a quiet and organized environment. Mr. Snow believes some quiet and focusing time provides a more assured learning experience. Conversation is mandatory, but one becomes more competent when he/she is able to focus.

The Teacher’s Approach

When discussing his teaching philosophy, Mr. Snow explained,

> Education is up to the student. The student is the one who wants to do the educating—he or she owns it. I only guide them. Their grade is only a grade; they did not get an education because of a grade. Education comes when the students put the effort into it. Students learn when they manipulate things, make mistakes, and try to figure things out. Learning is really taking place when they are out the classroom door. I assist them to start learning and thinking here; over there, they start on their own.

In this class, students learned to create a video game using the Scratch and Greenfoot programs. In the Scratch unit, students learned to make three games: (a) a

Pong[20] game, (b) an instructional game, and (c) a random game—whatever game the students wanted to create. Pong is a game that uses two paddles on both sides of the screen to keep the ball moving from side to side—like ping-pong. Although students started with Mr. Snow's instruction, they soon began to explore on their own to complete the game. It was fascinating to see how students' development of the same game differed. Whether in the coding or the artwork, each student showed distinctly different approaches. For example, for the Pong game, a girl student converted her game to a baseball field environment, with a photo of Coors Field for the title page, and a boy student made a paddle that was too short and thin, so it was very hard to reach the ball in order to win the game.

The idea behind the instructional game projects is for students to take something they know and create a game to teach somebody else that knowledge. It could be a basic math skill, a foreign language, or history lesson. Ideally students need to convey the information to other people in a joyful, fun, and engaging game—almost as if the conveyance of knowledge was in the background or delivered surreptitiously. In this project, the students would start working on a game from a "clean sheet of paper." The storyboard was required and shared with Mr. Snow. Mr. Snow noted, "When students were excited and wanted to make a game, that is the time they approach logical thinking with the computer language." For example, if I do this, could this happen? Logical thinking makes use of the cause and effect rules in Boolean algebra to write software. Again, it is all related to a conversation with the computer and how the player affects the

---

[20]Pong is one of the earliest arcade video games and is a tennis sport featuring simple two-dimensional graphics (Pong Game, 2012).

game. Trying to understand or anticipate how the player might interact with the game, what questions might arise, and the position he/she might present as a player is also tricky. Mr. Snow continued, “So students need to use logical reasoning, feel comfortable with the computer conversation, anticipate how the players respond, and consider further possible responses.” It was very interesting to see how students looked for solutions for their plan and coding that might help players interact and react with the game. Students worked 3 weeks on this game, and I believe their level of intensity and motivation kept them engaged with the task at hand.

The third project is open to the student’s choice for a game to create. Several students chose to work on the hero concept as a game. There were two students working on the maze game. I was surprised there was even a group of students who preferred to create an instructional game.

Mr. Snow and another technology teacher plan the curriculum together. The instructional materials include a worksheet, video, and information on the webpage used in class. In the technology class, there is a large amount of individual tutoring work, because the student is working on his/her own individual game with unique and specific questions. Everyone needs different levels of attention and help. This direct and individual guidance makes a great impact on students’ learning. Mr. Snow shared with me how his teaching experience serves his work and has evolved from last year to this. Last year, Mr. Snow guided students to play the Pong game: how to look at the way the game was designed and how the controls originally worked. However, the group I observed showed they did not need this rudimentary information. These students already knew how critical the Pong game was to the evolution of computer games and in particular, within the context of this class. So Mr. Snow asked students to make the Pong game and then complete the game with both title and ending pages.

Mr. Snow talked about how his teaching plan is based on how the group interacted:

> I have the repertoire of information and lessons I teach. I depend on the groups of students, and choice determines which one I should use. With this group of students, I started teaching how to make a game without looking at the games or comparing with last year's group. The next one, I might need to spend more time on fundamental instruction. The plan for teaching depends on the students and, as I have always said, they are their own teacher.

In this year's group, the students actively expressed how they wanted to make fabulous games and were then self-motivated to learn to make more complex games. Mr. Snow and I both saw how some students knew a great deal about the computer, whereas others did not, and how some readily approached the programming work, yet others enjoyed painting on the computer. Students are different, and each individual has a very different view on how to make a video game. Mr. Snow guided students to use logical thinking, pay attention to details, and express their creativity. Many times, students saw something in their imagination or from another source they wanted to do, but they soon found out how hard that specific game element was to develop on the computer. For example, Mr. Snow would then encourage them to think again and pay attention to whatever they saw while playing the game. The more the learner thinks, the more the learner learns. Mr. Snow said, "I teach them the basics; they use what they can to apply to their own circumstance. It is not only about what the teacher told them to do, but what they can do."

In regard to the challenge of teaching this class, Mr. Snow believes the hardest part is to interpret what students want. The feedback and reaction are very important. The teacher needs to know what he/she should prepare for the students and why. Mr. Snow expressed,

> The greatest challenge is, I try so hard to not to force students to think in my way. I have my idea how things work, but I am afraid to show my thoughts too much to them. They might think that is the only way it should be. If I encourage them to try different possibilities, they might bring some new way I never saw before. I do not want to stop their exploration because of the way I think. The second challenge is to help them to think and feel comfortable having a conversation with the computer, which is logical thinking directly involved in their work. I hope that the students will explore more and feel comfortable about it. The technology is changing so quickly, and students are changing every year. It is exciting, because it is always challenging. The challenge [is] to keep these computers close enough to up-to-date and running and for me to keep learning, so I can teach students what they need and want to know. That is the most challenging.

This reminded me what originally prompted me to conduct this study: Technology is changing rapidly, and our students hold different views of these technologies. How can we, as educators, help them learn with the appliances they grow up with and use every day?

Mr. Snow has prepared the instructions on the school's website for all the technology classes in the school to use. The opening sentences are: Technology is open to all students. Students will have the opportunity to explore a variety of media and applications that involve the use of multimedia technology and computers. His instructions, categorized in six segments on the school's website are as follows:

1. Creativity and innovation: Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology.
2. Communication and collaboration: Students use digital media and environments to communicate and work collaboratively to support the individual learning of others.

3. Research and information fluency: Students apply digital tools to gather, evaluate, and use information.
4. Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
5. Digital citizenship: Students understand human, cultural, and social issues related to technology, and practice legal and ethical behavior.
6. Technology operations and concepts: Students demonstrate a sound understanding of technology concepts, systems, and operations. (Mr. Snow's school website, 2012)

Mr. Snow described the purpose of this class in a way that genuinely moved me:

> I think the class here is different compared with other classes. In other classes, a student gets a grade of A, because he/she knows what the exactly answer is. But here, the student is a freethinker. He/she can build any kind of house he/she wants, whatever—a skyscraper or tipi. We, as educators, have to accept there are many different ways to complete a project, and we should support whatever thoughts are in students' minds.

Evaluation

By the end of the project, Mr. Snow would ask students to do an evaluation of other people's games. Mr. Snow prepared a form on the web through Google Docs[21]. Everyone could view all the games then write their comments. There are seven questions for each game. Each student needs to provide comments for a total of 30 games, corresponding to the number of students in the class. Part of the students' grade is based on the effort and time they put into reviewing the works of others and preparing their comments. Another ingredient is completion of the game they themselves set out to complete. Some students were ambivalent about the grading method and provided limited comment.

The questions to be commented on for each game are:

---

[21]Google Docs is a free web-based office suite and data storage service offered by Google. It allows users to create and edit documents online while collaborating in real-time with other users (Wikipedia, 2012).

1. What would have made it easier to control?
2. What was missing?
3. Was there anything in the game that was not clear? What confused you?
4. How were the graphics, color choices, text? Was everything easy to read?
5. Did the sprites and backgrounds make sense?
6. Did they belong with the game, or did they seem out of place?
7. The creator needs quality feedback. State politely if you would find this game entertaining enough to play again? What is done well? What could be improved? (Mr. Snow's digital evaluation, 2012)

Many students gave good feedback on the games. For example, "It was easy to control, but I think I got stuck on stage three"; "It would be easier if the sprite stopped bouncing around"; "If you considered more variables, that would be great"; and more. Some students even made more than three-sentence comments to some questions. I especially enjoyed watching the students making comments about their own game. They reviewed the work and used that perspective to think again about the game they had created, often in a very new way. This peer-to-peer evaluation is a good time to reflect on personal work, after gaining new insights from viewing and objectively critiquing other people's work. Some students would then apply that advice or observation from the work of others to their next work, and that is an excellent technique for learning.

However, there were still some students who did not care for this exercise and made unclear comments, such as, "I like it" and "Well done." For these students, making a game was more fun than reviewing the work. It appeared they liked the chance to play their peers' games, which showed their peers' efforts also.

Mr. Snow also spoke about how the grading system in the school is seen usually as the way of driving students to learn. Some students only care about getting the A grade instead of truly immersing themselves in the learning process. But some students want to learn only what drives their interest in learning—they are attracted to specific motivating factors. When students are truly excited by any source of internally generated motivation—organic motivation—this may be when they develop their best work.

In this class, Mr. Snow pointed out that most students are happy about what they have learned and done for their game. Some of them might not be satisfied about the game they created, but they had fun doing it. Some students still wanted to add something more or try something different for their game, even after they had already turned in their work. They are happy they can make a game, and although a few of them became cognizant of learning through this process, many still were happily unaware of the educational process they had just experienced.

Engagement

Mr. Snow commented, "These students wanted to be here. So it makes a big difference." The Access class is designed to teach students some level of computer programming skill and to make video games. As mentioned earlier, these students have to have a higher than average GPA to be able to join this class. These students were eager to learn more about making games. Some students found their motivation to learn to make games was because they like to play video games. As a result, they were drawn to this course.

"The teaching happened when students engaged to do and teach themselves," pointed out Mr. Snow, who always asserts the students lead education. Initially, most students had no idea how to make games on the computer; so many of them were scared in the beginning. But their eagerness to learn about game making drove them to work together to try the first Pong game project. Once students found that it was not that hard, they wanted to do more. Mr. Snow stated that their motivation results in their engagement. The school only provides the opportunity for students. These are good students and they want to grasp whatever they can. In Mr. Snow's words,

> Motivation is an encouragement of engagement, like a circle…. The best motivation is coming from the students, not me, not grade, not from mommy and daddy. It comes from them and their desire to learn the things they are interested in.

If students are motivated, they will learn and lead themselves to engagement.

Mr. Snow spoke about his family to his students, "I always tell my sons, 'It is just a little bit more thinking that will make your work different.'" For me, as researcher, it is a great encouragement to engage students to work together in this class, like a family. As Mr. Snow sometimes spotlights, students work *together* to make their games work. Making a game involves a large amount of programming work, and there is not only one method for the result that is sought. The hard work of making a game is made much more enjoyable when students work together under the guidance of a teacher like Mr. Snow.

Creativity

For Mr. Snow, the definition of creativity is, "taking things that are not related to each other and putting them together so they make something new." Several students commented to me, "The computer is much easier!" The computer definitely helps in typing a paper, preparing a PowerPoint presentation, or calculating math with ease. The final product is always clean and organized with the computer's assistance. Working on an art-related project, one can add color or texture with cleaner lines and shapes. In Scratch, there are effects for helping to create artwork for the background or character. With one specific effect, students can easily and quickly add the gradient color in a space they choose. It might not be according to a particular fashion, but it certainly is a fun discovery for students.

In the Pong game, I observed students had fun creating the colorful gradient background from pink and green to blue—as many colors as can be imagined. For example, students used many different colors for the ball. One day, I was wondering if any student rearranged the Pong game so the ball was not a ball. Then I saw one student made a bird instead of a ball for the game. Inspired by this creativity, some students seated near him also made some changes to their ball, such as a dog or a tiger. These are just some of the illustrations of creativity fueled by new forms of teaching and learning.

On one occasion, early in the class period, a student found in the Scratch program the music and sound block or sprite for his game. Immediately, several students wanted to add sounds to their game. The sounds in the classroom became louder and louder, and Mr. Snow needed to remind students about the noise level. I also observed one student who found the recorder program block for the sprite. He added his own voice for the sprite. Several students then had fun with this idea, and creativity was born from collaboration and discovery!

When I saw how the students had fun with their discoveries on the computer and put them together, I too saw creativity. As these students tried to explore more with the computer to enhance the quality of their work, creativity was born. They might not be a genius like Einstein or Edison, but they created their project based on their learning and exploration, and worked hard to realize their vision.

In this class, I observed that many students enjoyed making the maze game. But, everyone had his/her own plan for the questions, paths, characters, and other ingredients of the game. If the player made a unique move, the students wanted to give the player an "a-ha" moment. That is evidence of one element of creativity. There was one student who chose to work on an instructional "healthy meal" game to teach people about eating healthily, and another made a game for sharing his knowledge of movies. Both were interesting topics. Whereas other students thought about a lesson within school life, these students chose outside-school topics but still information they found necessary and relevant to share with others. Another student created a ghost story to lead a player to play a math problem-solving game, which was also interesting. It was so amusing to see him create a math learning game within a "hero/survival story".

Students' Response

Kevin. I noticed Kevin when he first began working on a Pong game. He combined music, fresh colors, and a disco dance club theme for his unique Pong game. In addition, he made a title and instructional scenes for others to understand how to play the game with the just right timing. This game immediately stood out when compared with other students' work. Then he chose to make a math game for the instructional game project. The game started with the story that a ghoul was going to turn a main character, "Fish Jack," into a character like the player, and both of them had a conversation. The game went like this: In order to survive, you need to answer the questions correctly; and if you did, the screen jumped to a classroom environment with the ghoul's question, followed by a space for answering the question. You could hit the up, right, or left key to move Fish Jack around. When you hit the up key, the fire tank pushed Fish Jack flying to the top. If you release the up key, Fish Jack would move back to the ground. There is background music with the game and, if you completed five math questions, you won!

Kevin provided a description of some of his thoughts and experiences related to making his game. Here, in his own words, is Kevin's statement:

> When started
> I tried three ideas, usually
> I researched other people's work, also
> I thought, I tried, I wanted to make it good
> A game about math could be fun
> I learned some Scratch in 6th grade
> I know I can make it right
>
> Coding is not easy
> Trying to find the right block is challenge
> There are many and many computer languages
> However, I do not think I use math for making my games
>
> Pretty much every day
> Friends tried my game
> Let me know if it was good or not
> But I am not happy with my friends' failure
> Because they did not work hard
> I am happy people like my game, and like to play my game
>
> The last game, I felt I needed two more days
> But, this one, I am comfortable,
> Finished it early as I thought
>
> The teacher's instruction was the key
> Every so often, I just needed individual guidance
> Computer is awesome and fun
> I can show my game to my little brother
> I talked about it to my mom
> I can make games instead of play games, now
> I can apply what I want to the game, for people to play
> I am proud of everything I did, I learned, and I will do and apply
>
> The game I created, the idea I broke into
> Friends played it, they enjoyed it
> I know they love it
> It is meaningful to me
> I like the school
> I want to make more games
> Social studies is my favor subject
> Maybe I will make a game for it, future

Being creative, and have fun!

According to Kevin's poetic statement, he enjoyed the game-making based learning project and was happy about his work. He indicated that he was sad about the failure some of his friends had encountered. He felt that their failure was because they did not engage with the learning process and strive, with commitment, to overcome the challenge. Further, Kevin believed he studied with his creative mind and was happy to have fun with both his creative and intellectual skills.

Emily. Emily, who is one of only three girls in the class, sat across the desk from me in the classroom, so we said "hi" to each other every morning. I observed her working hard every day. Emily is the only Muslim girl in the class. She still wears a scarf over her hair, but the color she chooses is always pastel, such as pink, orange, yellow, and blue, to match her clothes. According to Emily, she does not like black, and color makes her happy. Emily also told me she is a transfer student, and this was her first technology class. In the classroom, Emily usually worked on her own and often asked Mr. Snow questions with a soft voice. Her personality seemed to contribute to giving her game a very detailed look and feel for the players.

In the instructional game project, Emily made a game to teach movie information, because she loved to watch movies. She chose to work on a math game for the third project, and she talked more about it. Here, in her own words, is Emily's statement:

I love math, I thought math would be a good game
I wanted to make a game about math, I know
I wanted to make the game educational and fun
And I knew, I used math concepts while making games

I enjoyed using the computer, I hoped I can do it all the time

In this class, the whole process was bliss
Whether sprites, backgrounds, coding
Or keep thinking and thinking
Thinking up the questions was fun and challenging, at the same time
What kind of questions should I use
What the players would like
Keep thinking, keep planning
Not too hard, not too easy, please

I think a lot, I planned the game in my head
My parents, little brother and I talked, too
The teacher's words, support, and guidance, very useful
All of them helped me to think, try the possibilities,
and improve the quality of it is
I enjoyed it
I had fun with it
This is my first technology class
I want to learn more, indeed

The time period was just right
But I did some work at home, just because I wanted
Yes, I am happy about my game!
It was what I wanted
And I worked very hard
I learned it was a long-time effort
Worth it for sure

Drawing is not my skill
But I mixed colored pencils with my imagination
On the storyboard
That is what creativity is
How you create, so can be anything beautiful to you!
Next time, I want to make a maze game
The mouse goes to the maze to get the cheese
My little brother will be very happy about it too

Emily was a transfer student and did not have any previous experience with a technology class, but she knew she wanted to learn more about computers. Emily chose intriguing topics, such as teaching about movies and mathematics, for her projects. She thought about her project constantly and even worked during the weekend. Emily kept giving herself challenges in the design and coding of her game and worked very hard to reach the goal she had set in her mind. She even had a plan for a project of her own after the program work of this semester. These were all signs that she was engaged with digital learning and motivated to pursue the digital learning field.

Ted. Ted is a boy who just emigrated here from Mongolia. He is a quiet student and only asked questions of the teacher when he really felt he needed additional information. But he enjoyed sharing his work with friends. Ted made two maze games for his second and third project. Of course, the second maze game was much more advanced than the one he did before. Ted shared some comments about his experiences related to making these games. Here, in his own words, is Ted's statement:

> I like math, so I chose math for my game
> It was a math maze game!
> You went through the path, touched the box
> And answered the math questions
> Go through the whole maze game
> If the question was too hard for you, it would become easier with more use
> My last game was a maze too
> About geography
> This one
> I knew I wanted to enhance the quality of the maze game
> For sure
>
> It was not hard to think about the game, to do
> Looked at other people's work, gave ideas
> I used my imagination
> Everything was in my head
> Too hard to write done what I thought
>
> I did not know Scratch before
> I did not take any technology class before
> I always know I want to be a game designer when I grow up
> I never lost interest
> I know that is what I want to do
>
> I enjoy using the computer, searching for whatever
> I like to do artwork on the computer, much easier for sure
> Lines are perfect, shapes are nicer, colors are great

There are many tools you can use
Basically
I want to use the computer all the time
I want to do a cool three-dimensional game in the future, too

I thought the questions for the math game were not easy
Coding is not easy
But I like this challenge
I normally figured it out on my own
I did not work at home
I only could use the computer here at school
I talked with friends about games
But, did not help
When I really needed the help
I talked with the teacher
He gave me the thoughts to keep thinking more
If it was really too hard, I was sorry I had to let it go

A typical day:
I came in,
I tried hard to think what would make the game cool and what was important
I believe I had 100% engagement
I learned to think about the timing, movement
How to move the characters
A good timing for one scene to the next one
What the player should do if something came out
Games were cool and the character could fly
Which stimulated me to think more

I am proud that I can make games now, and it is not a mass of work
The first game
I did not care much and all lines were not straight
This one
I made them much cleaner and organized
This learning is very important to me

I can make games now
I know my games are not high level yet
I think some friends were very good
I need to learn more and I want to learn more
Use my imagination, all kind of possibilities, for my creativity

Ted was new to living in a Western country, but he had already made up his mind to be a video game designer one day. He also mentioned how the exciting digital game environment stimulated him to constantly connect with learning and working. This is obviously another example of how the students' motivation drove their engagement to keep learning. Ted remarked how use of the computer made his general work much easier and more organized. He mentioned, for example, he could draw cleaner lines and shapes while using tools on the computer, along with using various search engines to get information simply and quickly.

Josh. Josh is an African-American boy. In my conversation with him, he showed a lot of respect for his parents and commented that his dad helps him explore more technology fields, such as making a website and teaching him to learn step by step. In the instructional game project, Josh made a spelling game. The player had to reach 50 points in the first level, then the game would speed up for the next level. The third project was a game about a dragon, a princess, and a witch. The player or the dragon moved to reach the princess before she became the witch. It was a quite different game compared with that of the other students. Here, in his own words regarding his experience, is Josh's statement:

> This is my first technology class
> But I use computer, a lot
> My dad helps me to build my own website, now
>
> I play games a lot
> I know I want to make games
> I want to be a game designer, the future
> I am glad I am in this class
> I can use computer to do something
>
> I talked with friends

They played, gave feedback
The teacher showed us how things work, how to use it
Especially why not to use it
Higher engagement I had
Because I knew what I was doing and what I wanted to do
The favorite thing was doing the coding
But I have to admit figuring out
Chose a topic for the game, was challenge to me

I am not an artist and I cannot draw
I got pictures out from the Internet
A great tool we all use nowadays

I worked on my project
Made it better and better every day
I played other people's game
Helped me to think
Think outside the box what other people do and do not do
Now I know I can make games
I want to make more complex games

I am proud that I can make games and I was not struggling
In the beginning, I worried it would be too difficult I might not do it well
It is still not easy, but I know I can make it better and better
I know I will do better when I get old

Four weeks for a game was about right
A week to think and started it
Two weeks to work
One week to review
The evaluation helped me to think
What other people do and what I can do

I am happy with my games
I did a good job and people enjoyed it
I want to do more and more
I want to use my computer skill more
Show the math teacher
How I can make perfect shapes, angles, and games on the computer
I am creative, look for inspiration and
I want to share them with my friends and families
Expand it more

According to Josh's poetic statement, this was his first technology class, but he discovered a love for coding and the strategy behind coding. Whereas many students chose a more basic task, he chose a complex one that reflected his own interests. Moreover, although it was not easy, the fact that it was something he was personally committed to inspired him to work very hard and not mind the extra level of effort required. I believe that is a key to a successful learner: motivation from within. Josh even mentioned his attention was focused on when the teacher taught about things to do and not to do in the best practices for coding.

Behind the Scenes

I remember a time a few days before Halloween. The weather was getting chilly, and most students added one more layer of sweater on top of their t-shirts. On the morning ANN news, students and teachers were talking about Halloween costumes and a contest. Some anchor-girls on ANN wore funny wigs to make people laugh, providing a hint to remind students Halloween is a time for fun. A cat is always a fun but creepy icon for Halloween. The icon for Scratch is an orange-colored cat. I even noticed students adding a mask or cape to the Scratch cat.

That morning, one student first made the Scratch cat a red color with a black background. Then he revised the colors again in another scene. He had fun and continued to try several styles and animations with the title, "Cat." Eventually he made the Scratch cat as a creepy Halloween cat with some added animation. He showed the cat to some friends, and they all liked it and commented he should show it to people in the school's Halloween store.

Obviously this boy worked on the cat animation instead of schoolwork. But he had fun and used his creativity on something he just learned, Scratch. Can the computer techniques taught in school be used only for the school project? I assume not. This boy enjoyed what he did on the computer and hopefully will want to do more. Over time, he might explore something new without any instigation or regulation. As Mr. Snow has mentioned, “When a student needs to take a break and examine something fun, he might learn something valuable from this experience.” I hope this student will keep exploring more towards what he can do with the technology.

My study does not include the consideration of gender while approaching technology in learning. However, there were only three girls in this class, and Mr. Snow stated that, from his teaching experience, it is his belief that boys and girls think very differently while planning, working, and finishing the project. The girls I observed in this class normally think about their concept and game elements a few more times than do the boys, seeking to make sure that each element is exactly what they want for their work. The boys in this class seemed to want to start working immediately, and “cool” is the key factor they want to pursue. Mr. Snow noticed girls at this age usually tend to communicate clearly and verbally. And girls are very concerned with the way to do things, for example, “if I should fix this problem or not.” Or they may wonder, “If I got rid of it, how would it affect my plan?” When girls meet some coding problem while working on their game, they try to fix it. But, if they cannot get it to work precisely the way they want, they would make sure the player follows a specific set of directions to achieve the process or steps they set out in their game. Instead of focusing on fixing the coding, they would fix the problem with an explanation. The three girls in the class all showed similar characteristics in their thinking about the game. Mr. Snow expressed that from his teaching experience, there is always a difference between boys and girls.

There was a boy and a girl of Mexican heritage who sat side by side, and they both created a similar game: teaching how to speak Spanish and English. The girl provided clear instructions in English and Spanish, and the player could choose to learn either language. To explain, in the scene for learning Spanish, the player can click from nine objects and then hear the pronunciation and see the written word. The next scene has seven phrases in Spanish. When the player clicks one of the phrases, he/she can hear the pronunciation and translation in English. Once the lesson is completed, the player is greeted with a congratulations scene, with celebration items and the Mexican flag. There is a similar lesson if the player chooses to learn English. In contrast, the boy's Spanish lesson was only one object in one scene. The player clicked the object to hear the Spanish and hit the spacebar to go to the next scene. Thus, there is a very interesting difference evident in the final product of their language teaching games. I wonder if this represents the individual differences between these two students or the difference in the thinking processes between genders.

Several students brought breakfast to the classroom every morning, as mentioned earlier. According to Mr. Snow, 80% of the students in this school sign up for the free breakfast program, and he believes this is an indication that students and their families might have a financial problem. I was told there are not many students who can afford to own a personal computer, laptop, or mobile phone in this school. Accordingly, Mr. Snow tries very hard to provide an equal learning environment for every student and makes sure the same curriculum and use of the computer is equal for everyone without considering his or her individual background. If a suburban public middle school facing economic constraints in their population of individual families proposed policies, such as the use of an iPad as a textbook, which several scholars have recently suggested, such policies would be difficult to adopt. Several students stated that they only use the computer in school, using it during lunchtime and after school to increase their access time. It is clear they are very attracted to computers as a learning tool. Whereas I firmly believe that the District, and certainly Mr. Snow, want to provide an opportunity for the use of computers and other technologies for all students, educators must be sensitive to the financial constraints of their District as well as the student families. Technology may very well be a great application for learning in the digital age, but it may also be another economic dividing line for learners.

At the end of 4 weeks, students completed their third project, creating whatever game they wanted to make and then started the evaluation process. At this point, students focused on reviewing their peers' games as well as their own game and writing their comments on the evaluation. During the process, they played the games by themselves and wrote the comments by themselves or with friends seated next to them. It was also the day before Thanksgiving break, and everyone was excited to take time off and be with their families. Mr. Snow kept reminding students that they could continue writing their comments when them came back from break. Some students still asked if they could make a copy of the Google Docs evaluation form to be able to work at home. These students wanted to complete the work and be ready for the next project, the Greenfoot game.

Although a 45-minute class always felt as if it were finishing too soon, students were ready to wrap up and leave for their next class when Mr. Snow instructed,

> We will continue working on the evaluation after coming back from the break. But if you want to work on it over break, that is good too. Then we will start learning Greenfoot. There is only one assignment for you; enjoy your Thanksgiving break with your family! Have fun and enjoy the holiday as much as you can!

Mr. Snow always remarked that the family is the most important thing; the second is education. Students are so fortunate to learn under Mr. Snow's instruction. This assignment of priorities was nurturing for the students and encouraged the involvement of their families. I was also very encouraged by Mr. Snow's teaching methods and style. Learning was fun, students seemed to be well motivated, and I found this to be an active class with strong "ownership" of a student's work and a real drive for the process of learning.

Mr. Winter, Technology Teacher

Mr. Winter, an easy-going, cheerful man in his early 50s, joined Apple Middle School 32 years ago, starting as industrial arts teacher. Mr. Winter notes that the computer assignment served as one of the teaching components begun when he first taught the industrial arts course. His responsibilities at that time had also included teaching math and science. Because of this first opportunity to create a computer lesson, Mr. Winter became more involved in teaching the computer class, increasing his enthusiasm to the point where he became a formal technology teacher 6 years ago. He has been a guest speaker and instructor at Adams State College, Phoenix University, and Colorado State University, with the course topics including industrial arts, class management, and methods of teaching. Mr. Winter provides varying curriculums suited to his students' needs and adjusted for individuals in his class, and this has made him a successful technology class teacher. His focus on this level of individuality is based on his belief that each student approaches assigned projects differently in pace, level of difficulty, and capability.

In the past, Mr. Winter has left his curly grey hair short, along with his beard. However, when I first started observing in his class, he had shaved all his hair, which gave students a surprise. Some students commented to Mr. Winter about his hair. He explained that he had shaved his hair off for his mom, because she was not happy about becoming bald from her breast cancer treatment. Mr. Winter's use of humor to make his mother happier represents a consistent theme in the way he relates to his students. In addition to using humor with the students, Mr. Winter's personality is shown by his style of short hair, brown-framed glasses, Polo shirt with a variation of colors from pink to black, cargo shorts, and white tennis shoes. This gives students a sense of his amiable nature, which contributes to their respect and ease of approaching him in any situation. Thus, students feel comfortable coming to talk with him and using the computer or other technology tools during lunchtime or both before and after school.

Mr. Winter keeps his computer classroom open for students from 6:30 in the morning to 8 or 9 in the evening, explaining that he would be happy to see students coming to use the technology rather than walking the streets. He is always there to provide whatever his students need. According to Mr. Winter, some high school students still come back to use the technology available in his classroom for their schoolwork or whatever project they are the working on. He also supervises the daily school news production, Apple News Network (ANN). The work of ANN usually runs throughout the day. Mr. Winter focuses his attention on his regular class, ANN, and schoolwork from the moment he first walks into the building. His class covers several computer and technology programs, ranging from Microsoft Office; video productions, such as iMovie and QuickTime; sound editing, such as Sound Studio and GarageBand; drawing programs, such as InkScape; and digital photo programs, such as Photoshop, to the game program, Scratch.

For this study, I observed Mr. Winter and his class using Scratch 1 hour and 25 minutes every other day, from the 2nd week of October through the 2nd week of November. I then continued to sit in on his class and conducted interviews with him and four pre-selected students through the end of November 2011. The 30 students in this class constituted a very diverse ethnic group, with a mix of White, Hispanic, African American, Asian, and Muslim students. There were seven girls in the class—only 23%. The following descriptions of Mr. Winter and his class are organized into the same six sections used previously: the classroom experience, the teacher's approach, engagement, creativity, students' response, and observation from behind the scenes. These provide a deep depiction of how teaching and learning in a technology class is done in a middle school in suburban Denver, Colorado.

The Classroom Experience

"So, today, everyone has to finish the assignment on the InkScape and bring it to me. We are going to start learning to make a video game." Mr. Winter announced the agenda and a new project. Suddenly students showed excitement with their smiles.

When I began observing Mr. Winter and his class in October, students had just finished their previous project, drawing shapes on the InkScape[22] program. Mr. Winter mentioned students were normally comfortable with outsiders being in the classroom, and proving this point, two different students came up to introduce themselves to me, asking why I was in their classroom. I introduced myself as well and let them know I was in their class for my own research study. These students then began asking me if I could make games and talking about their eagerness to learn to make games. I was excited by their desire and willingness to take up this learning challenge. It was clear these students were very enthusiastic to learn to make games on the computer.

I observed that some students showed Mr. Winter their work done in InkScape, whereas others started to play games on the Scratch website. Mr. Winter suggested that students start by first playing a game and getting to know the interface. He believed students should have some understanding of what kind of games and working environment they were going to explore. In the next class period, Mr. Winter started to show the games students had done in the past, projected on the screen on the wall. Students were silent and focused on the screen. Then, before students began working on a game exercise—a ball-collecting game—they would started working through the tutorial to know more about the Scratch working environment and get Mr. Winter's guidance. Students could then choose to work on their individual game after this introduction.

The best learning strategy, according to Mr. Winter, is learning step by step while "doing." As he always said to his students, "Follow the instructions now, and you will

[22] Inkscape is a free program used to edit vector graphics and provide a graphical user interface for the editing of such diagrams (Inkscape, 2012).

understand it better and easily make your own game." Some students were eager to make a game and possibly thought it could be as easy as just clicking a key. But there is a lot of thinking and planning involved. For example, the student must ask him/herself, What do you want your characters to do, and how do you make them move the way you want? Teaching the concept of making games is not easy. Making games is not like writing a paper. Students need to learn to plan the characters, background, transition, coding, and so on, and be able to explain them to Mr. Winter.

Mr. Winter believes the teacher needs to break down the operation of the game and explain the components to the students. Eventually, students could begin to think how to apply these concepts so they can direct the game character to work according to their plan. A teacher like Mr. Winter always strives to empower students to build a foundation of knowledge, then explore their work more independently, instead of telling them what they should do at every step.

Mr. Winter provided one exercise to inspire students to think by writing down the instructions, step by step, of describing just a single movement of an object or character. He gave students the following example to think about: "Within your game, how might you move the water bottle on the table in your seating area to another table?" Mr. Winter wanted students to consider several aspects:

- How do you turn a certain number of degrees in one direction or another?
- How do you point to which direction and walk?
- How many steps do you need in order to do these movements?

On the four sides of the classroom walls, Mr. Winter has written down 0 degrees, 90 degrees, 180 degrees, and 360 degrees. The student could then indicate his/her own location based on the degrees on the walls. Students had fun working on this exercise and helping each other. Some students preferred to stand up and test how to follow the steps. At the end of the class, Mr. Winter asked students to text the instructions to a friend. From where I sat in the corner of the classroom, students enjoyed playing this exercise and even caused a traffic jam in class, because they were excited to test the directions in person. It was a significant exercise. While students were having fun with all these detailed movements, they reflected on what statement or computer instruction they needed to use for the character's movement on the computer.

This exercise was the first real application using math concepts they already knew. It helped them understand such concepts as how a game maker keeps characters in the x and y location or how he/she moves the character only by numbers. Students learned to define the coordinates to move their characters. Further, students learned how to use numbers to express speed of movement, because all these concepts were based on math, giving them a new way of expressing mathematical concepts they had previously known only in the abstract.

The storyboard, a graphical expression of a proposal, was an exercise students also practiced in class. Mr. Winter explained, "I showed students the way I use the storyboard, but they can do whatever they want, as long as they can start creating a conversation." At their age, students in this class might not think about producing a beautiful storyboard, but at least it is a first step towards understanding communication. "When a student starts creating his/her own game, he/she starts designing a conversation."

Mr. Winter went on to explain about the concept of conversation. It is a conversation between the game maker, computer screen, operation, movement, and the player. While learning to make games, students learn to build a bridge between the game maker, the computer, and the player; so they have to think of all possibilities. He explained that this is a form of non-linear thinking. Compare this with writing a paper where you normally start writing from the beginning to end. In game making, the game maker needs to consider all courses of action simultaneously, and he/she can then start making a game from inherently different approaches. He/she does not have to start making a game from the first scene but must constantly consider all possibilities for the game he/she plans. That is why the working process is very different in technology class.

Mr. Winter spoke more specifically about the practice of non-linear thinking in his class. Most students are used to what they have been trained in linear thinking and so tried to use these concepts to complete a game from one scene to next. In the context of non-linear thinking, students would provide choices at different game levels for the players; the continued tasks and rewards are then based on the players' choice or may even incorporate surprises based upon a movement or combination of actions.

Most of the time, students first needed to explain the game they planned to Mr. Winter and their friends. The clearer the explanation they provided, the more they understood how to approach writing the code for their game. Quite often, I could hear Mr. Winter asking students to write or draw more details for their storyboard as his way of prompting them to think more thoroughly about their story elements. The process of articulating their game served to help them think in a more non-linear fashion and incorporate all elements of the game they visualized.

When students first entered the classroom and before specific instruction began, many practiced typing using a program on the computer, for about 10 minutes. Sometimes, Mr. Winter would ask students to sit in a group by a small round table, where he discussed projects and specific work with them, or he engaged the whole class in this manner with the use of an overhead projector. When Mr. Winter wanted to demonstrate something on the projector, all students moved their chairs to be closer to the screen on the wall. When he asked for a volunteer to work on the computer, three students immediately raised their hands, because the engagement level in his class is very high. Mr. Winter asked these students in turn to demonstrate tasks on the computer for all students, such as opening the Scratch program, creating a file, setting up a stage, and creating a character. He also reminded students to remember to name the stage and save the file, focusing on both the basics and the complexity of their work. All the students were concentrating on these three students' work. I observed that students actively participated in the learning process and enthusiastically sought to engage with it in any way possible. Mr. Winter continued to talk about several options to make a game more interesting and entertaining. For example, the art work for the characters and background, and possibilities for movement were discussed as ways to continue to fuel students' creativity.

One day, I heard Mr. Winter give the following example as his response to a student's question:

> If your mom asked you to watch TV together, you would think and respond "yes" or "no," then thought, "What channel should you watch?" Mom clicked the channel you agreed on. One hour later, if your mom said, "It is time to sleep," you would turn off the TV and go to your bedroom. But if your mom said, "Good

> night," and she went to sleep, you watched TV by yourself, and the TV was still on.

This was his way of illustrating the possibilities of cause and effect in a game. This student had a question about coding for one movement, and Mr. Winter used this example from daily life to explain the possibilities.

Coding in game making was a challenge for students. It was particularly difficult for them to understand how they would incorporate real world movement and reaction. Again, Mr. Winter believes this is because students have been trained in linear thinking in many of their other classes. If any student were having a hard time figuring out the coding process, Mr. Winter would ask him/her to draw the pictures again, breaking down one statement per line. For example, George stands up, and then George goes to the right. Students would then take this statement and go back to the program to find the proper Scratch code block to construct the movement. Some students might start putting things together right away, whereas others might use the tutorial and follow what other people did or use a combination of those approaches.

The greatest challenge for students, however, is not about coding. It involves the whole task from the beginning, approaching new software and working processes, to the final completion of the game—visualization of the whole versus the component parts. According to Mr. Winter, along with the motivation of making games, the students must understand the sequence, logic, rules, and concept of a game that determine how things have to happen in order for a game to function. This becomes another challenge for students. It is not only about constructing programming codes for a game, but how one combines all these considerations together to make the game work.

Some students frequently asked for guidance, but others preferred to think on their own. Once, I noticed a student showing his curiosity as his gaze went back and forth between the computer screen and his notebook. I saw him writing something in his notebook. So I went over to talk with him. This student pointed to the screen to tell me the game he planned to do and that he had written down the entire Scratch block coding in his notebook. Some students are independent thinkers. They learn more by exploring various possibilities and thinking on their own. When approaching these students, Mr. Winter would select questions to highlight their thinking and continue to foster this form of thought.

Most students did not spend too much time thinking about the game they wanted to make. Usually the game students wanted to create was based on whatever they thought at that moment. There were a number of students not aware of how complicated it is to make a game, because they were new to this field. Thus, in the beginning, some students wanted to make a high-level game, filled with concepts and programming, that was above their current level and tool set. Most of the time, Mr. Winter needed to restrain these students to a greater simplicity or break their game down to a less complex game, due to the underlying difficulty they might encounter in the actual coding. Some students shared with me that looking at other people's games, such as a friend's work in class or a game on a website, helped them think and overcome the challenges related to situations where their ambition exceeded their skills. Most students liked to talk with Mr. Winter and sought his suggestions. Sometimes, he would suggest that a specific student talk with another student who, he felt, had thoughts that might apply to his game or just for inspiration.

Students usually were excited at the beginning of making a game. The middle or more task-oriented part of their working process was very difficult when compared to the excitement of first starting to work on a game or at the end when the rush is on to complete their tasks in a timely manner, because they wanted to apply a more interesting but complicated plan to their projects. Mr. Winter spoke about how a teacher keeps students motivated and their interest high throughout the game-making process. He likened this to climbing a mountain: If a student faced a cliff with fear, he/she would lose the joy of challenge. If a student whined about the hard work or got frustrated about his/her work, for example, “I have worked all day, and I am finished with it,” Mr. Winter would talk with him: “Let’s see if we can work through it.” Students sometimes responded, “But it is too hard.” Mr. Winter would then suggest that the student take a break or do something else. Sometimes, walking around the classroom to see how other students’ games were evolving might reenergize this particular student’s motivation. Mr. Winter would give this student time to recharge. He wanted to let students understand how important the task was and that was why they were working hard to solve the problem they faced in developing their game.

Mr. Winter indicated that students learn to solve problems while making games. Just like building a Lego skyscraper, students look at the parts available, the programming code, and the concepts they have in mind for completing a building in software. If students put all pieces of a Lego building or a game in Scratch together randomly, it does not function. Students need to first think what they want the game to do and how it works now, and then how they can fix the problems. It is an ongoing thinking and problem-solving process. Mr. Winter continued with this line of thinking: “[If] students hold onto their imagination for the game they want to do and learn to fix the problem, it is like the wheel that does not stop."

Every day, when students came to class, they drew, figured out the programming codes, talked with the teacher or friends, then worked again and fixed the problems they may have encountered, building their game with the new insight and knowledge they had acquired through this learning and collaborative process. Students felt comfortable when they were in control of the game and understood how they could fix the problem they had come across. I was very impressed when students completed their game and immediately began planning for their next game. The statement of accomplishment, "Yes, I made it!" was a vivid expression of students' gratification and meant a lot to both them and their teachers.

Sometimes, students would invite me to play their games. For example, the ball-collecting game was a game where a bar or panel on the bottom of the stage would collect balls falling from the top. One student showed me the basketball court and basketball he used for his game. The theme of basketball definitely made the game more interesting. This student also talked with me about the game he was going to do next: A fish eats the coins from right to left and back and forth. He said his grandmother helped him find this idea for the game. An advanced student who had learned Scratch before did a game about an airplane gathering numbers in order from 1 to 10. The numbers would change positions randomly when the player continued to play the game in another round. He explained to me that he first used a car but thought the airplane would be more interesting, and he planned next to make an even higher level of this game. A few days later, I noticed this student made a game similar to the ball-collecting game most students had first worked on in the class. But instead of a panel or bar for collecting the balls, he made a monster-nanny to carry another monster falling from the top. If the player, which is the monster-nanny, collected 10 monsters, the monster-nanny changed to a piece of cloud or a pile of bricks, and displayed his/her name.

Once, a student waved his hand to me, “Do you want to try my game?” I responded without thinking, “Yes!” and went over to play his ball-collecting game. It was Mr. Winter’s aim that everyone can win the ball-collecting game. However, this student made the speed of the falling ball very fast, and there was no way I could catch any balls. So, there is always the possibility of making a game too hard to win. Several students went to play his game after my test, and it was fun to see students engaged with other students’ work.

A number of students liked to incorporate sound or music into their game. Because Mr. Winter had taught sound programs before, such as Sound Studio and GarageBand, some students learned from his teaching experience in this area and then enjoyed recording their own sounds or modifying the stock sounds for their own use. Some students used InkScape to create their own artwork or Photoshop to restyle the pictures for their characters and backgrounds for the game. The tools and functions in the computer or technology equipment, such as digital cameras and scanners, stimulate students to contemplate a variety of more possibilities for application in their projects, because these tools promote their imagination.

Mr. Winter used the example of getting dressed, such as when a mother tells her son to dress for his grandmother’s birthday, the boy knows to choose the proper outfit and dresses well to be ready for the party. Similarly there are many applications and functions students can use, and they learn to understand which one to use for their particular needs. In this class, every student worked on his/her individual project. Even if students worked on the same assignment, such as the ball-collecting game, they all had different plans for both the game and process. Students at this age carry various perspectives while approaching the process of making games. Whether they wrote the instructions at the beginning or conclusion of the game, each student brought his/her own view to the entire process.

Mr. Winter explained how time affects students' process of learning. Some students' need more time, because the way they process the underlying tasks is different from the norm. The teacher therefore needs to reflect on the individuals' needs in the class and within the curriculum. For example, if a student was enthusiastic to learn but needed more time, Mr. Winter would let this student work before or after school, or during lunchtime to complete his/her work instead of failing him/her. Mr. Winter cannot base the grading criteria only on the student's level of achievement. Moreover, he is in favor of providing the opportunity for students who want to learn according to their own pace and access to time, as well as the instructions for learning.

> At the end of the semester course, Mr. Winter spoke to me about his students: Whenever they came in, whatever they did, whenever they walked out, they have worked on making games and were proud of sharing it with other people. That is always the best thing that really moved me. I am happy when these students are proud of their work. Whether these students followed my suggestions or not, they have learned something they are satisfied [with] from this making-game experience.

Classroom Environment

When I walked into Mr. Winter's classroom, various posters on the wall immediately surprised me. It is Mr. Winter's nature to enjoy working in an amusing environment. He told me that he has a collection of posters ranging from the movies and advertising to holiday celebrations, from different places and countries. Every year, either his daughter or students would go through all his posters and post their selections on the walls of his classroom. Students seemed to feel joy and comfort working in this environment. Mr. Winter stated that he wants his students to work in an amusing environment, and thus, these various posters might inspire them.

Below the posters, there are 27 computers placed side by side against the four walls. There are also 10 computers in the center in front of Mr. Winter's desk and two computes are set to one side. There are six scanners connected with the computers on one side of the wall. Because Mr. Winter manages the ANN production, there are many technology devices in his classroom. There is one cabinet full of video production equipment, with nine digital cameras as well as digital video cameras kept in their containers. Students need to deposit their ANN ID or a note with their name each time they check out a camera—much like a library card process. A smaller cabinet next to this cabinet is filled with tripods. There are also three computers in this corner dedicated to the ANN production, and Mr. Winter has ordered three high quality chairs for use with the ANN production.

Mr. Winter's desk is in the off-center position of the classroom. There is a trolley on the side with various power supplies for battery charging. There is a black-and-white printer for Mr. Winter's use but a color printer on one side for the use of any of the students. The computers for students' use are also connected to a black-and-white printer by the front door.

I have seen how busy Mr. Winter is every day in taking care of his regular classes and students, the ANN production and its student staff, and many other tasks and events in school. The stack of papers on Mr. Winter's desk never really seems to shrink, because his commitment to learning and sharing with his students is his driving force. He truly cares about his students, and this is made evident by the tremendous workload he takes on.

There is one small round table and a big rectangular table on one side of the classroom. Mr. Winter often uses the small round table for discussing with students. The big table is a useful working space for students, whether they want to discuss a project among themselves or with Mr. Winter, write as a group or individually, and much more. In addition, there are many other technology devices available in the classroom, from one Mac with a 27-inch monitor in one corner to a table for still-life photography off-center in the classroom. There is also a VHS player with a small TV on top of one cabinet. Mr. Winter's classroom is the very embodiment of the modern public school computer and technology lab.

The Teacher's Approach

Mr. Winter spoke about how his experience with Scratch had begun randomly in the computer class he took a few years ago. In his words,

> Scratch teaching first came to me when I took a computer class in the computer science department at the University of Denver about three years ago. I learned the program in the summer; then my co-worker and I started to teach it in the fall semester.

Mr. Winter found the Scratch project useful for his class. He believed the interesting combination of the conception and interaction of a game-making based learning project motivated students to learn game making. In his view, the major goal is to start training students of this age to think of many different and divergent possibilities for solving problems.

Students at Apple Middle School usually attend World View High School when they graduate and then continue to prepare themselves for the possibility of studying at the Colorado School of Discovery. It is a recent development that during their senior year, students can choose to study mathematics and technology classes in the new technology building, which connects Apple Middle School and World View High School. In their high school years, students continue to explore higher-level mathematics, science, and technology studies in the new building of technology. Mr. Winter hopes the technology class he provides in middle school will assist them to consider this work and broaden their viewpoints and thinking for the future.

Mr. Winter and his fellow teacher have incorporated the game-making program into the 6^{th}-, 7^{th}-, and 8^{th}-grade classes, plus one, dedicated, semester-long course. The class unit usually runs 2 to 3 weeks. The 7^{th} and 8^{th} grade classes run longer, because students have usually had experience from their previous study of the subject. Within the current structure, the class I was observing is about one-and-a-half weeks long, and the teacher and students meet every other day. Mr. Winter believes this is about the right amount of time to assist students to learn game making in the Scratch environment. If students want to practice more, they can choose to attend the course the next year or attend a semester-long course that another technology teacher offers. Students who are beginners to the program would work on a Scratch working-environment exercise, such as the ball-collecting game, along with the option of an individual game. The advanced students would pursue more complex projects based on conversations and planning with Mr. Winter.

The computer class Mr. Winter took at the University of Denver was a full summer program taught by the computer science department, and the instructors focused on the strategy of the game and programming code, as well as art and design theory. Because Mr. Winter is the teacher of a middle school of 500 students, most of whom have no art background, his priority is how to cultivate students' interest in making games. The goal of this class is to teach students assorted technologies and inspire them to continue thinking and using these devices and techniques outside the class. The challenge is in how a teacher can assist students to get into game making quickly and arrive at a satisfying finished project so that this process of learning is rewarding to the learner, while providing him/her with the skills and concepts of programming as a problem-solving tool.

Mr. Winter usually starts teaching making games by showing students the games previous students have made. The most important consideration is how to capture students' interest and attention. Then Mr. Winter lets students go on to the Scratch program to explore what things they can do, using this level of engagement to make the process more engrossing for them. The tutorial is a great tool to get students excited. Students soon learn how they can move characters around the game and create fun backgrounds with the pen and paint effects in the program. Mr. Winter explained that this was a time when he could see what created this particular group of students' interest. He could then lead them through more formal instruction on the various things used for making a game more interesting.

Mr. Winter spoke about his philosophy in learning to make games: “If a learner had fun, he/she participated in learning. Once he/she figured out one game, he/she could apply it to something else.” He explained that as long as students do the work, complete the minimal curriculum requirements, and keep working to improve their final project, they will be successful in learning. The ball-collecting game shows students the structure and use of a variety of tools in making games and gets them to start thinking about this process and its application. Students can work on their individual games after this exercise. Some students chose to make a modified ball-collecting game, whereas others really wanted to take up the challenge of working on a completely different game.

Mr. Winter encouraged the students who had previously learned Scratch to make a learning game to teach something, for example, math, a foreign language, history, and so on. The instructional game teaches students to achieve a higher-level of thinking about what a game can do and how they can use this knowledge in other areas of their life. It also helps students think about the full range of options and events as they approach one problem or another. For example, if a student needs to organize his notes, he could use the program to organize these notes and develop a game to help himself or others learn the task.

Mr. Winter really hopes students can use what they learn in his class and apply it to other learning experiences. However, individual teachers have their own views as they see technology assist the learning process. Mr. Winter gave the following example about divergent viewpoints between a teacher and student. When a student was told to do a report in his science class, he created an animation to demonstrate what happened in the lab. He gave it to his teacher, but the teacher had only expected a written paper and did not appreciate this different form of presentation. Mr. Winter commented,

> As things become smaller and smaller, as the iPad, iTouch, and their like become cheaper, I hope we will see students use them more and more effectively, and I hope that teachers will view the technology differently and agree that a different form of presentation is valuable in and of itself.

By the end of this conversation, Mr. Winter expressed his wish again: “It will be sweet if students can use these [presentations] to overcome their limitations.” Mr. Winter believes such technology will enhance students’ learning experience over time.

“The objective of this form of education is to help students to learn.” Mr. Winter spoke here about his philosophy of teaching and added, “If you are a teacher, given enough time and instruction, you can teach.” Preparing instruction is always his first consideration. Mr. Winter was active in collaborating with his associates and applying not only articles they had read in professional materials, magazines, and newspapers, but also their experiences in class. This scheme served to integrate updated programs and trends into various curricula to meet the needs at that time and place in a student’s learning. The projects students do in class always involve what people do and know now and how people are currently engaged with the world around them. Also, Mr. Winter emphasized the importance of the time element—how much time is available to teach each program—as well as the lessons considered important in each project. Because the primary focus is education, Mr. Winter wants to provide the best forms of enhancement to learning while incorporating technology into the educational environment. Mr. Winter added, “We [even] tweet constantly what we teach. We need to bring these up-to-date things to education.”

When the technology class was first established, Mr. Winter and several technology teachers listed the basic skills students should know. For example, Microsoft Office is always number one, but Mr. Winter wants students to understand not only typing or PowerPoint. He believes it is mandatory to teach students how to understand the whole working environment instead of the common understanding of just using the individual program. In Mr. Winter's opinion, students are smart and can function well with the computer, but most of them did not interpret the tools they could use for specific application in real life until they explored more. For example, Microsoft Word is not only for typing, and making games in Scratch is more complex than just clicking the enter key. Mr. Winter is glad that he has instructed students how to approach the game-making environment, and digital environment as a whole.

Mr. Winter always emphasizes that he facilitates students instead of teaching them: "Teaching is more lecture, and facility is more about helping students to learn from adapting their work….We give students the concept and idea; they run with it." He stresses a safe environment as very important in his technology class. There is no right or wrong answer in this class or while making a game, because everyone has his/her own habits, tools, and visions. The technology class is not like an English or science class, where students always need to prepare for a single correct answer. At all times, Mr. Winter makes his students know that anyone can make a mistake, and they always have an opportunity to continue fixing their project until they feel satisfied with the result. There is no blame for an error, because there really are no errors, maybe only inefficient application of the tools or even insufficient application; but Mr. Winter confirms to students that each of their efforts is intrinsically worthy. This is also a part of Mr.

Winter's personality; he does not believe in failing a student. He makes sure that students create and build their plan with constant effort and refinement until they can confirm learning was achieved.

Engagement

Students are engaged when they are involved in their work, carry on challenges, and accomplish their work with curiosity, delight, and motivation. Students experience pride not simply by earning a higher grade but from involvement with their work and an active desire to participate, using all of these experiences to achieve gratification in their learning processes and in their lives (Jones, 2008). When I saw students listen, observe, and try to pull together all the work they had done, I realized it was because they enjoyed what they were doing in Mr. Winter's technology class.

In this classroom setting, there were students from the regular class, students working on the ANN production, and a few students with varying degrees of a learning disability. Most of the time, students from the regular class were busy with their own work or discussions with friends seated nearby or with Mr. Winter. Once in a while, I would see students raising their hand and asking questions or volunteering to undertake some work when Mr. Winter asked for things, such as operating the computer for everyone or handing out the work paper. Students in the ANN production group were looking at or editing a video, or planning their next project in their ANN production corner. The place where I was seated was not too far from the ANN production corner, and their hard work in reviewing the video or using the cameras always got my attention. These students knew their responsibilities and were very motivated to complete this work to the very best of their ability to benefit the whole school. A sense of pride and ownership in their work was clearly evident. Students who had varying degrees of learning disabilities were also focused on their work at the computer, getting help from the class assistants or other students in the class, or working on their own.

Everyone was engaged in his or her own work even though each was different. When students wanted to share their games with me or asked me to play their game, they showed how they were proud of their work and wanted others to be more involved. I was happy to see that students went over to help the learning disabled students by showing them instructions step by step. The level of participation, motivation, and engagement was high, and from my observation, the technology was clearly a key to this level of commitment. There were more than a few times when Mr. Winter needed to log-off individuals' computers from the main server on his computer to stop students' working, so they would be ready for their next class.

The teacher is the basis for success in this environment. How a teacher inspires students to become deeply involved in their work is pivotal to the learning experience. That is exactly what Mr. Winter delivers to his teaching and classroom learning. He pointed out, "We interact with each other, and we learn and influence each other. When I read or see something that would enhance students' learning experience, I bring it to the class." When he saw students were happy with their work, Mr. Winter said he knew the students were engaged, and that, to him, is fulfillment as a teacher.

Creativity

Mr. Winter commented, "I think all students are creative." Students working on new techniques while making a game or coloring a picture show they enjoy the process and experience in this new adventure. It is all imbued with creativity. Creativity is not limited to product or process innovation. Sometimes, one could see students getting ideas from each other, though they did not turn in exactly the same work product. The evidence is seen in how many students made a modified version of the ball-collecting game. In one instance, the game was on a basketball court; a different story involved a monster and monster-nanny; and in another scenario, the ball was a bullet shooting a brick at the top of a wall. The games were similar, but each one showed an individual plan and personal attachment to the concepts developed by the student. According to Mr. Winter, when a student is willing to learn something new and invest what he/she knows, he/she may be applying one element of creativity. These students all practiced the use of their creative minds.

Most students at this age want to do something different, to stand out, and they want to show off how their games are cooler than other people's, as a sign of both competition and pride. Once these students see something interesting from a friend's game or games on a website, whether it is color, story, sound, music, or animation, they want to incorporate or adapt it if they can, for their own use. There were a few students who developed a very appealing game simply because they had made some mistakes in coding, which led them to make their game function differently. I must agree with Mr. Winter: These students appeared joyful while making their game, and they practiced creativity in nearly everything they did.

Students' Response

Eric. Eric is a typical American boy who always dressed in a t-shirt, shorts, and running shoes. This style of dress confirms he is representative of all the students at Apple Middle School. Eric took the technology class with Mr. Winter last year. In actuality, Eric told me that he learned Scratch in the 4th grade when his brother was learning Scratch from Mr. Winter. In this year's class, Eric made a game about darts shooting different colored balls as targets. The darts could point in any direction and in random places to shoot the targets. There was a lot of mathematical thinking and use involved in order for the darts to point in the proper direction for shooting the target. Also, there was a green-colored bouncing ball behind the target, and the player would lose if he/she shot it. When interviewed for this study, Eric provided a snapshot of his game-making experience. Here, in his own words, is Eric's statement:

> I have a darts board at home
> I want a connection with it
> Making the darts move was not easy
> But I had fun
> I like math so I knew
> I would challenge myself to make this game good
> I talked with the teacher
> I discussed with friends
> I never wanted to give up
> It is fun here, comfortable here
> Not hard at all
> Not feel pressure at all
> I am proud I put a lot of work and time on my game
> I always have high engagement, the technology class!
>
> Not too hard to think up a game I wanted to do
> I did not check the website
> I did not use the sketchbook
> I knew what I wanted to do
> I did what I wanted to do
> Two to three weeks for a game was about right
> Would get bored if it was too long
> Be nervous if it is too short
> I completed the work, improved it
> I think I did a good job
>
> I learned Scratch when I was 10, my brother taught me
> I am pleased with Scratch, with the computer
> Some friends liked the computer

But did not focus on work
Some had a hard time
Because did not follow the instruction
Some were serious and wanted a good game done too
I am proud I can help friends
I can share what I have learned
Typing is always pleasing
Photoshop makes photography fun
Research on web, recording the music, making the PowerPoint
All good, all joy, I want to learn more!
However,
When calculating math
I would still use pen on paper

Creativity is something worthwhile
Put a lot of effort into it
Using the newer technology
Whether iPod or iPad
Will be different and more fun!

According to Eric's statement, he did not have a hard time thinking of a topic for his game, and he provided help to his friends throughout the class. He felt that two weeks for making a game was about right; otherwise, he would get bored. While speaking about technology use, he indicated that he enjoys using the computer for searching the Internet, typing, modifying pictures, or organizing music, but prefers calculating math problem with a pen and paper.

Peter. Peter was always seated by the door and discussed his games, favorite video games, or anything related to video games with his friend, Tom. According to Peter, Tom was a friend who suggested he take the technology class last year in 6th grade. Peter told me in the interview that he needed to review his notebook for a few days after coming back from summer break this semester. The review made Peter think more about games, and he planned to practice regularly in the future. Both Peter and Tom have fun and plan to learn more through high school. Peter indicated that in 6th grade, the technology class was more about basic computer learning, and he learned to make a simple game in Scratch.

In this year's technology class, Peter made three games. The first was an instructional game to teach math. The second one was similar to the ball-collecting game most students did in the class, but the bar on the bottom needed to catch whatever fell from the sky. The third game was a personal challenge he set for himself: to figure out how to make a background change within a maze game in the center. He used the tools and techniques in Scratch to emphasize the changeable background colors within a maze. He also mentioned that his friend, Tom, helped him think of ideas for the projects. Peter related some of his thoughts and experiences about the game-making process, highlighting his enjoyment and pride, as well as appreciation for his friends and the teacher. Here, in his own words, is Peter's statement:

> I joined the technology class when I was a 6th grader
> My friend said it to me
> I like it and I want to keep learning more
> I made three games this semester, so far
> Not too hard
> I had fun
> Testing the game, my favorite one
> Since I didn't know what it could be
> Learned much from sharing conversation with friends
> My friends definitely impact what I think
>
> The teacher helped a lot too
> Inspired what I can do
> Sometimes, made me to think harder
> Sometimes, stories made me to think more
> Critiquing projects, made it much better
> Not sure about the storyboard
> I knew what I want to do, in my brain

I like to play video games, at home
I like to type, play games, and search the web about my games
But I do not work on my game at home
Sometimes
I complete a game in one day, interesting
I often worked during lunchtime
But, when I was bored
I do not want to do it, at all
However
I will be fine and keep working, the second day

I like art and technology
I like making 3D things out of clay
One day I will make 3D things on the computer
I will use more math for my games

1st game took two weeks
2nd game took six days
3rd game took only two days.
Time affected learning for sure
If I did not practice often, I would lose what I know
I am proud I gained more confidence
And I can make games
I can make it through the challenge, all the games
I like my games the way they are
I am proud of what I did

Did not take too long to think up the game, to do
I hope I can view other friends' games
More viewing, more inspiration
A friend made a game with different music
I will do it one day too
Creativity
Is creating instead of thinking
Like making a game
You plan, think, and create

Peter stated that the more he practiced, the less time he needed to complete a project, and he felt he needed to continue working with the technologies he has been exposed to in this class. Also, conversation with friends and the teacher always helped him think of various strategies for his projects. From his work in this class, he gained more confidence with the use of digital technology.

Sophia. Sophia is a Muslim girl, who always wore the culturally customary scarf, and her big eyes under the veil showed her ambition and tenacity to work toward the best project. That was exactly what Sophia accomplished in this class. In the ball-collecting game, she finished her game 2 days ahead of the others and started helping several friends seated near her. She also decided to make a complicated game—when a bomb hits a dog, the dog would randomly become a different animal. This was a very creative outcome for a middle school student. By the end of this semester, Mr. Winter suggested that she join the ANN production, and she started training and working with the team. Also, Sophia liked to wear her pink tennis shoes with a large amount of paillette on them. I did not get a chance to ask her if she had made them or not. But her colorful shoes reflected her ardor for life and her work. Here, in her own words, is Sophia's statement:

> I want to make a game people would enjoy
> A game about animals, I decided
> The idea in my head, five minutes
> Storyboard helped to plan the game, out of my mind
> I used the scratch paper for my animals
> Scanner was useful
> Coding was challenge
> Making a game on my own was my favorite
>
> I did not know much technology
> But I plan to learn more
> I enjoy making games, more
> Typing was hard, will pursue more
> Love it more and more, never lost curiosity
> I have 100% engagement
> With the class
>
> Think outside of box, important
> Look at others' work, inspired to think new

But I do not want to do the same as other people
Talked with the teacher, lots of benefit
Shared with friends, stimulated me to think far
Teacher's explanation and friends' remarks
Motivate me to work hard, extra

I like math
I know I used math in making games
In language art, giving a correct answer
But, in math, figuring the answer out
Challenges are equal, in math and technology
Test and test
Puzzled out for a fit final

Two weeks for a game, just right
I finished it on time
A little time to think about the game to make
More time to deal with the code
If there was more time
Challenged a complicated game, indeed

I learned coding
I can use the coding to tell the computer to do things
My friend also stretches the coding
Beginning to be fluent
We can make things worked easily on the computer
Amazing

I am proud of my game
It is meaningful to me
It showed what I can do and how I can present myself
I am proud of my game
It took a lot of hard work, but I made it
Never give up
I am proud of my game
And I am happy for my game
It worked out well
The way I planned
Creativity is expressing who you are inside of you

Based on Sophia's statement, she discovered a love for digital technologies from this work and was very proud of her new and growing capability. She had a great attitude while approaching a new subject, such as digital technology learning, and was not afraid of new challenges. Plus, when she thought of a topic for her game, she immediately knew she wanted to make a game other people would enjoy, besides its being solely her game, showing a strong sense of community.

Helen. Helen sat opposite from the projector, which is on my left side in the class. I could view her work easily from where I was seated. Helen took a technology class with another technology teacher last year, and she feels more and more comfortable with the computer. As did the other students interviewed from Mr. Winter's class, she talked with enthusiasm and energy about her game-making experience. Here, in her own words, is Helen's statement:

> My game is about a shopper
> Moved around to collect the cheese puff from the sky
> If you collected 20 of them, win
> If you lost 10, lose
> The teacher shared some ideas
> But I like mine and I made what was in my mind
> A different experience, this year
> Learned more coding, good practice
> Design the characters and background, enjoy
> More stuff to learn
> More stuff I want to learn
>
> There is a difference between making and playing a game
> When you play, you only think how to get more scores
> When you make, you need to think a lot more
> Practice more, you will learn
>
> I had trouble, the beginning
> The teacher helped, extended
> Made me to think, deep and more
> Talked with my mom, a little bit
> Some feedback, some improvement
> I do not copy what other people did
>
> Never lost interest

It is something I want to do
I want to be in the class, all the time
Did not know much, last year
But it is fun and fun
I want to take the class
Again and again

I shared my work with my friends
When I tested, they came to look
Any problem I had, if they knew
I asked the teacher for help, useful

I learned a lot, for sure
Did not know movies, game making before
There is a lot you can do on the computer
I want to make more games and my own website, future
Friends learned more too
Did not know much before
But operate it good now

I like art, a lot
Drawing, painting, and clay
I used my art skill in my game
Background, characters, superb

I have a computer at home
Check e-mail, play games
Calculate math, for my homework
A lot of features I can use
I can arrange photos nice
I can draw shapes, easier and perfect
But, Facebook, not use often
Also
Do not work my game project at home

Not meaningful to me, really
It was a simple game
Everyone can do it
Not too much challenge
I want to make more advanced games

I am proud I am in this class
Learned a lot from this experience
And I can help other people too
Creativity, expressing yourself

If you want to do something
Try, do, and have fun
Add more imagination in your work

Helen emphatically declared the project was not meaningful to her and that anyone could do it. But she enjoyed learning of diverse uses with digital technology, such as Photoshop or making movies. She has also decided to continue taking technology classes in 8th grade, adding to her learning experiences in the 6th and 7th grades. She was proud to say about creativity, “If you want to do something, try, do, and have fun!” Helen did show her appreciation for her teachers’ support.

Behind the Scenes

There were a few students with learning disabilities who had joined the technology class. Different degrees of physical and mental disabilities were represented. Some students had been diagnosed autistic and needed a tutor to assist with their learning. Other students needed a special instructor to help them with everything from basic conversation to moving around the classroom. Based on my observation and conversations with Mr. Winter and the specialists, these students showed substantial interest in computers. From my vantage point in the classroom, I could see their smiles when they worked on the computer. Although it may be an expressed theoretical notion that it is a common phenomenon for disadvantaged students to be very engaged with computers and other technology, it was very obvious in this class.

On one occasion, a learning-disabled student had a hard time logging onto the computer and started showing his irritation. Another student, Ben, went over to help him. Ben tried several techniques to log onto the computer and finally made it work. The learning disabled student showed his gratitude with a smile shared with Ben. Ben then continued to log onto the Scratch program and performed some coding operations with this student. Another time, one of the students with special needs had a bit of extra fun with the computer, making some queer sound, which made everyone in the classroom laugh. He then turned his head upwards and laughed with everyone, showing his joy in the accomplishment and the resulting validation given him by the class. There was a disabled female student who sat in a wheel chair with a pillow to hold her head in position. This girl had serious physical movement problems and frequently needed to take medication. Mr. Winter adjusted the way the keyboard was fastened to a holder device on her wheelchair so she could use the keyboard from her position. The learning disability specialist mentioned how much this student liked to use the computer, and the student hoped she could use the mouse in the future to expand her engagement and accomplishment. It was very touching to view these students' contentment as they worked with their computer.

Two other learning-disabled students were autistic and usually had a tutor working with them. One of the students, Luke, was a boy always showing his affection for everything and everyone he encountered. When Mr. Winter asked students to watch the overhead projector, Luke would run to stand by him. Several times, when Mr. Winter asked students to operate his computer to show a process to other students, Luke, asking to do it, would raise his hand. Once, Luke did all the tasks without Mr. Winter's help, and I know Mr. Winter, his tutor, and even I, were very proud of him. By the end of the Scratch project, Luke completed his own game with the help of Mr. Winter, his tutor, and some other students. I remember seeing his smile and hearing his loud voice, "I made it!" He could not wait to show it to more people. That was a stunning moment of an autistic child having achieved something measurable from his interaction with a computer—a non-judgmental device tolerant of any number of mistakes, repetitions, and more.

It is normal to encounter a naughty student in class once in a while. Ben was not a problem student, but he liked to talk with friends instead of working on class projects. Ben was always noticeable, maybe because he liked to make fun with other students; he talked quite like a grown young man. Ben reminded me of Brad Pitt because of his hair color and trendy outfit. I suspect Ben's mother has a modern sense of dressing and life, and both have influenced Ben's acting like an adult. In the class, Ben started the tutorial and ball-collecting game with the group, however he did not complete the game. During class, Ben found software that enabled him to record several pieces of video and combine them together. There were about four class periods when Ben was having fun with the video recording and making jokes with friends next to him. He was serious in his acting like a comedian in the movies, whether by himself or in conversations with friends. He played the video fast-forward and back, or often at his own speed. Also he found the way to change the color and apply special effects to the video. Obviously, Ben did not pay attention to following the formal curriculum to make a game, but he found something interesting to engage him to learn more about the tools at hand in class.

I have referred to ANN, the Apple News Network, which is a news service announcing school activities, special events, and general news produced by students, with Mr. Winter's guidance. ANN has run 11 years and was started as the result of the principal's goals and belief in its value. The school's teachers, staff, and students all appreciate this activity to learn more about activities in the school's broader community and the world. Usually, 7th- and 8th-grade students organize the program, and selected 6th

grade students, recommended by teachers, are trained towards the end of the semester. The ANN production group met every morning and continued to work off and on throughout the day. According to Mr. Winter, students learn the planning process, video recording and editing, speech, teamwork, and more from this activity. I observed that students understood the benefit of participating in the ANN production and worked hard to produce the best quality work every day. From my professional background and photography training, I could tell that these students' hard work and Mr. Winter's instruction served them very well in using various camera angles, picture framing, and video editing.

It was in the beginning of October when some anchor-girls on ANN talked about a girl who won a contest, and how the prize money would be used for the school. The contest, promoted by the retailer, Big Lots, asked for a video production about anyone's particular school. This girl heard about the contest and went to talk with Mr. Winter. Basically she wanted to produce a short musical play about the school. Clearly, Mr. Winter would provide her with whatever level of support and guidance she might need, but instead, this student had the entire plot in her mind and began sharing it with her friends. On the day of the video production, about 150 students showed up to participate in the production. In the first 20 minutes, the girl taught everyone a dance she had created for the show. Then, Mr. Winter and other students used multiple cameras to film the dance in three scenes. Next, this girl edited the video, added the music, and submitted it to the Big Lots contest. Mr. Winter was very proud of this student. It was a great honor, and the reward went to good use at the school.

Ms. Moore, Technology Teacher

Ms. Moore has been teaching at Happy Valley Middle School for 13 years. She began her career as a 4th and 6th grade teacher for 6 years in California before joining the staff here in Colorado. Happy Valley Middle School is a high-accomplishment 2-year, 7th- and 8th-grade school committed to building an educational community through parental involvement and communication. Ms. Moore was hired as a math teacher and currently is teaching the “double dosing” math class, which is a class for students who are three or four grade levels below their age group. Because of her high level of skills in technology and her master’s degree in educational technology, Ms. Moore also supported teaching the 7th grade technology class.

Ms. Moore is a tall White woman in her mid 40s, with a smile that lights up her face. She keeps her brown hair cut a little shorter than shoulder length and usually wears it down. She is very casual and highly approachable, with round black-framed glasses and comfortable jeans, or sometimes a fun outfit matching the themes of the school’s “fun outfit” days, for example, hat day, goofy day, or school color day. Students always feel comfortable talking with her.

Ms. Moore had an opportunity to learn to use the computer a few years before she went to college, where she became highly interest in technology. When she decided to study for her master degree, she chose the educational technology program. Ms. Moore appears to be a great fit for teaching a technology class, demonstrating a love for technologies and all they comprise. She also uses technologies to accompany her math class teaching. Last year, Ms. Moore received a grant, acquiring 10 laptops for teaching in her math class.

In her 7th grade technology class, Ms. Moore teaches various software programs, from Google Docs, Excel, poster design, and smartphone to Scratch. In this research study, I focused on Ms. Moore's teaching and learning of Scratch. In this particular segment, students learned to make games via two exercises and one final project. The two exercises included (a) an animation of four letters from the student's name, and (b) a maze game. The final project was open to the student's personal plan. Ms. Moore prefers to use the term "project" instead of "game," because she does not want to limit students' usage in the program Scratch. There are many features students can learn and do on Scratch besides just making games.

I observed Ms. Moore and her technology class 55 minutes every day from the middle of January to the end of February 2012. I interviewed Ms. Moore and the four designated students in the last week of February 2012. Students learned to use Scratch and then made three Scratch projects in this period. There were 15 students in the class, 13 of whom were White; 1 student had Asian characteristics and the other was of mixed Asian and American decent. There were 5 girls in the class. The following descriptions of Ms. Moore and her class are organized into six sections: the classroom experience, the teacher's approach, engagement, creativity, students' response, and observations from behind the scenes. These provide an in-depth depiction of how the teaching and learning is accomplished in her technology class at a middle school in suburban Denver, Colorado.

The Classroom Experience

When students came to class in the morning, usually the first thing they did was to check their e-mail, provided for them by the District, which proved a good way to communicate with the classroom teacher. Ms. Moore also prepared the calendar and documents, sharing the syllabus with her students. For example, the first day Ms. Moore started teaching Scratch, she had already placed instructions for the class activity and the Scratch website on Google Docs. Students opened the Google document once they had read the e-mail from her, then went to the Scratch website and played some games on its website. Comments were heard from the students, such as "Wow, it is so fun!" "I like this one; I want to make a game like this!" and "It is so interesting!"

I observed how students showed their excitement about the upcoming new project. According to several students, they did not know much about the projects they would get to do in this class. Some students thought they would get chances to use the computer and learn about it, whereas others thought it might be an easy class. However, they did not think there were many fun things they could do on their school computer, for example, *making* video games besides *playing* video games. Students then opened the Scratch program and checked the elements on Scratch that Ms. Moore listed on Google Docs.

Ms. Moore started teaching Scratch by leading students to create a folder and become familiar with its environment. One student responded, "It is not easy." Ms. Moore said to him, "We are exploring. The more you do, the more you learn!" She pointed out that learning from making video games is also learning about becoming patient. Students nowadays expect things can be achieved immediately. For example, images can be retrieved from the Internet in a few seconds, and phone numbers can be reached from a mobile phone immediately, instead of looking for them in the phone book. According to Ms. Moore, most students in the 21st century are used to instant gratification, but they also need to learn to be patient with the processes of learning. This teaches them the life lesson that some things are not always easily reached.

Meanwhile, Ms. Moore encouraged students to check every single block in Scratch and try a basic movement, such as walking on Scratch: “Click the different blocks to learn what you can do with each of them. Just like going shopping, you need to walk around to check what you want to buy.” Ms. Moore reminded students to experiment and not be afraid of the software and computing environment.

The second day, students came to class and checked the e-mail and calendar as a routine “first thing” they did when they walked into the class. They were told to play the “Alien” game in the e-mail from Ms. Moore. Then Ms. Moore spoke about coordinates x and y as an understanding to be learned in this exercise. When I asked if students knew they were involved in math learning while making video games, she commented that she usually led students to logical thinking while dealing with math concepts in game making. She believed that talking about math directly usually slows or lessens students’ motivation to learn about the project. Instead she tried to keep them focused on the goal of its being a fun digital project. Ms. Moore also shared with me about games she used in her math class, to which students would say, “Wow, I didn’t know there is math in the games.” It was Ms. Moore’s philosophy that students learn based on what drives their attention; the subject to be learned then comes into their focus.

Ms. Moore showed her students an animation a previous student had done and invited them to play the game on the SMART Board. This allowed her to introduce the exercise they would do over the next few days: a simple animation of four letters chosen from their name. She talked about how the goal of this exercise is to be familiar with each block in Scratch. Before the class ended, Ms. Moore concluded the class by asking the students what they could do on Scratch, with several students replying such things as movement, color, shape, and so on. It was obvious the students were learning and engaged with Ms. Moore's instruction. Ms. Moore announced to the class again, "We will experiment and have fun with it during the next few weeks!"

At one point, a girl came to talk to Ms. Moore about having installed the Scratch program on her computer at home so she could show it to her sister. Throughout the whole trimester, this student regularly sent herself her work process through e-mail in class, so she could continue working on it at home. She definitely showed a high level of motivation in this class and wanted to learn more about making video games.

In this trimester, Ms. Moore invited a game designer to speak about real work in the game industry. A few days before the game designer came, she asked students to write down on Google Docs the questions they wanted to ask the game designer and e-mail them to the class. She also reminded students that it is good to think ahead. Such an experienced teacher teaches students the attitude for work, and this simple exercise infused in them the process of planning, using the computing tools, and working as a team. When the game designer came to talk, students showed their surprise at what he shared from his experiences in the field. Students later shared with me that for the most part, they had had only one technology class experience, which was in 3rd grade; and so, learning about the video game industry was somewhat overwhelming to them. They did not expect to see the intricacy of video games production.

In the second exercise of the maze game, students started practicing with their imagination to plan their games. In this maze game, Ms. Moore asked students to set up some obstacles besides walking from the start side to the exit. From the corner where I sat in the classroom, I could see several students raise their hands, eager to tell Ms. Moore their plan for this game. In this age group, students would think up something fascinating to surprise their teacher or want to work on many ideas in one game. A teacher like Ms. Moore must help students understand the need to adhere to a simple plot for their games and remind them not to make it too complicated. In this regard, Ms. Moore explained to the students,

> The complicated game you want to do needs more complicated scripting that you need to work on now. It is only your second exercise. If you are not ready for too complicated a game, it is okay. Let's make the game simpler, and you will not be frustrated with it. If you have more time, we could add more. I promise, there are more games we will work on. You also can keep your ideas for your games to use in the future.

In this maze game, many students worked on two-level games, with an instruction screen in the beginning and the win or lose screen at the end. Students learned to establish the basic relationship in their game in between these simple steps. Game makers must help players understand how to play a game with a reward for their progression in understanding, while finishing a game. The communication between a game maker and player is the first and most important lesson.

Once in a while, I could hear Ms. Moore remind students to save their file. In my view, saving a file is like keeping one's written homework nicely in a binder or folder for future use. Regularly saving one's file to keep the work up to date is also a pivotal lesson in the digital world. Once the file is lost, usually the only solution is building it again, which would not be an enjoyable process.

“Can you come to look at my game? The monster is not moving the way I want,” asked one student to another classmate. In the class period, students usually focused on their projects, and even the quietness of a bug would disturb the completion of their work. But, once in a while, I could hear students asking for help from each other, besides asking for Ms. Moore’s assistance. Ms. Moore encouraged students to help each other, and regarding this process, believed it is compulsory for the more proficient students to aid in the success of both the group and individuals’ work. The concept of peer teaching is very important to these tasks.

When most students had almost completed their maze game, they asked Ms. Moore to test their game. In one instance, she commented on a student’s game: “I like it, because there is a challenge.” A little bit of challenge to encourage players to play but not too much is good. She also said to another student, “It is very good. Now also think about what other things you can do for your game, maybe the shapes, sizes or colors could be different from one level to another.” Ms. Moore kept suggesting possibilities to enhance the quality of a game, even though the maze game was only their second exercise. The students’ imaginations had them continually thinking about all the considerations in making a more complex or evolved game. Students learned the game strategy step by step every day. For example, a student asked, “How can I add sound?”

Learning happens while students think and then raise questions. This is one way of showing how knowledge is constructed by the mind of the learner. Resnick (1996), a professor at MIT, always said that students do not get ideas, they make ideas. Ms. Moore smiled and motivated students to think about what they could do to make a game more interesting, once they finished making the first generation of their personal game.

The final project was open to students to do whatever they wanted. They had 2 days to look at games on the Scratch website and plan their project. During the process, students needed to write down their plan and e-mail it to Ms. Moore. In the plan, students were asked to provide a good description, from beginning and middle to the end of their game. Planning is a pivotal stage for a triumphant project. Students not only thought about the plot of the project but also the title, characters, interactions, levels, backgrounds, transition, and more. Ms. Moore spent two class periods discussing the plan with individual students to make sure everyone was on the right track. Again, she wanted to make sure each student had a rational plan incorporating the possible features in Scratch over these 3 weeks. She also encouraged students to think of a project besides one that is game based, because Scratch is designed for various digital tasks. However, the students in this group still chose to make a game. In the previous class, some students of Ms. Moore made animated stories instead of games for the final project.

I am in full agreement with Ms. Moore that good planning is a way to make her and her students' work successful. In the Scratch project, students usually commented about their challenges in coding. However, the challenge is more about putting more into what they thought and translating it to a realistic plan. Ms. Moore expressed that if students would have completed planning for their game and developed a clear understanding and order to their thought process, they would not encounter as much struggle in achieving the desired result.

When I asked Ms. Moore why students are excited in her class, she explained that students have the chance to do what they want in this class, whereas they normally do not have such freedom in other classes. In Ms. Moore's words,

> It is the freedom they enjoy. They can use their creativity to explore more of what they want to do. Like this girl who wanted to add the score bar to her game and she figured it out on her own. If that was what she wanted, she can do it.

Such freedom provides reward that results in self-encouragement.

Students enjoy having the chance to work on the computer. In this class, they have freedom to plan, decide, and work on the project while learning the diverse elements of the software. Scratch is friendly software. Students can learn and do it without much discouragement. With their manipulation, students make a completed and final production, which they can share with their friends and family. They expressed their pride as is made evident by their sharing their work. Moreover, Ms. Moore said, "The only limitation in this class is time. I need to set up a deadline for each project. Otherwise, students would keep exploring and want to add more to their project."

Students had 3 weeks of experience with Scratch while learning and doing two exercises. Some of them shared their thoughts for their games when they came to class in the morning: "Do you want to test my game later?" and "I am going to import my own sounds for the game."

Again, communication is a key in learning. In game making, game makers need to help players understand the game and engage them with clear and friendly instruction—similar to the process of education. A few times, I heard Ms. Moore asking students to speak again of the plan for their game and make sure it was clear that this was what they wanted to achieve.

One Monday morning when students walked into the classroom, Ms. Moore had a game on the SMART Board ready to discuss with them. She encouraged students to play the game, then asked, "What is wrong with this game?" After seeing two students who went on to test the game, several students responded, "There is no instruction." "The speed is too slow." "It is a very cute game, but I do not see the point." Ms. Moore carried on the conversation and reminded students of several issues in making games. Communication and a clear explanation are keys. Students then continued to work on their own project.

On that Monday morning, some students had questions about their games for Ms. Moore: "Ms. Moore, I have a question." "I am confused with this step." I assumed these students had worked on their games over the weekend. Ms. Moore was very please with this group of students' work attitude. The way to know if students are learning can be easily observed if they can speak about their work or have any questions for the project. "They keep thinking of the possibilities for their game, and sometimes they had hard questions for me too." Making a game on Scratch stimulated students to think more about their basic idea and build upon it; in turn, they had more questions they wanted to discuss with the teacher.

Ms. Moore also encouraged students to play each other's games, but reminded them to be both nice and honest. Ms. Moore instructed, "Don't just say you do not understand the game, but let this person explain it to you. Also, you can let this person know what you do not like about it." Sharing comments with the game maker is definitely a part of learning for the digital citizen. Some comments heard from students when playing each other's games were,

"It is way too easy."

"Oh, you can turn left earlier before seeing the monster."

"I like to play Bill's game. It is so easy."

"Come on, brother, you can finish it."

"It is going so fast. I need to slow the speed down."

Finally, it was almost the end of the trimester. Many students were ready to wrap up their projects. Among the15 students in the class, I could see individuals were working hard on their own project during the class period. Some were testing friends' games, and some were busy getting sounds with their earphones on, while others were still focusing on their project to push it to be a final work of the best quality. In this trimester, students could ask for a pass from their teacher to work individually on their schoolwork for 1 hour after the regular class period. Some students were constantly asking for a pass from Ms. Moore; they wanted to push to the last minute. With just one more day, all students needed to turn in their final project and also got a chance to play other students' games in class. That was the activity students enjoyed the most.

Classroom Environment

There are three computer labs in Happy Valley Middle School, two of which have the built-in SMART Board for instruction. The lab Ms. Moore used for her technology class is set up specifically for teaching a technology class. Ms. Moore shared the lab with two other technology teachers. There are 6 computers set in four different rows, with a total of 26 computers in this lab and 4 in another area of the school. There is a built-in cabinet with shelves and two printers against one wall. Around the classroom, three different technology teachers shared their posters or panels for teaching and learning on the walls. Ms. Moore had her six Scratch animation hints on small panels posted on the front wall of the classroom next to the whiteboard, and once in a while, students went to check them.

On one side of the wall next to the SMART Board, there are some posters Ms. Moore shared with the students that expressed well her beliefs regarding education. A big poster with a red swirl drawing described the process of project development in the computer environment: research, idea, plan, create, reflect, evaluate, and display. The students' research and planning, together with good communication with their peers, are critical to a successful project and learning experience. The smaller poster on top displayed a quote, reminding students, "Teachers open the door, but you must enter by yourself." Teachers are the vehicles of instruction to prepare students, with guidance, to pursue the best accomplishment, but students need to understand learning comprehension is driven from an individual's attitude and behavior. Next to these two posters, there is also a panel with the x and y coordinates and the Scratch cat in the center, as a reminder to students about area location within the Scratch game.

Besides Ms. Moore, other technology teachers using this classroom also shared many tips with students using reminder posters, such as how to log-in, file types (e.g. pdf and jpg) for saving picture files, tips for keyboard shortcuts, good and not good pictures for using in their projects, a reminder to shut down the computer at the end of day, and more. These provided useful tips for students' review while working on their project. The presumption was that the more exposed students are to these fundamentals, the more they will remember them.

The desk for the teacher is set in the front of classroom but toward the left side below the whiteboard and not too far from the SMART Board on the next wall. It was very convenient for Ms. Moore to show her demonstrations on the white board or SMART Board. However, during the class period, Ms. Moore always walked the classroom, supporting her students with her friendly demeanor and approachability, answering any questions, and sharing conversations with them.

The Teacher's Approach

While describing her teaching philosophy, Ms. Moore explained,

> I try to reach every student, and teach whatever I can to them—whether the actual curriculum or the social skill, like getting along with people, or how to survive outside the school. Not all students have families supporting them, and I try to be there for them no matter what. There are some students who have trouble with schooling, and I try to help them to be comfortable in the learning environment and take it forward to be a good citizen.

Regarding the place of technology in education, Ms. Moore pointed out that learning about and with technology is definitely a lesson to help students become acclimated with this digital environment and be a part of what it means to be a digital citizen functioning within today's technology environment of learning and living. She added,

> We live in a society stimulated by digital technology, whether you get money from an ATM machine, pump the gasoline, or more. I hope I can help students to be comfortable with this environment. They do not need to be excellent engineers,

but be capable to use and enjoy the digital technology without being impatient or distressed.

As I observed, Ms. Moore usually starts the conversations about computers and technology on the first day of the class: "Do you like to use computer?" Do you think you are good at it?" Students would then begin to feel less anxious with the class. Ms. Moore always tries to reach each student, making all the students feel comfortable with the class activity by ensuring that they understand what and why they are going to learn the particular subject matter. This clearly illustrates the attitude of her teaching philosophy.

Ms. Moore continued to talk about her goals for teaching. Recognizing that digital life changes so quickly, she hopes she can help students be able to do what they need to do—pursue what they want to do, because the ability to learn with technology's evolution is central to modern life. She wants to help students see there are many tools out there, hopefully exposing them to these programs and showing students how to use them in everyday life. Students may then reach the goals they need for their life or future jobs and successfully compete in society as is required. The educator's job is to prepare students with what they might need and help them keep up with the pace of life.

There are 12 weeks in a trimester at Happy Valley Middle School. Ms. Moore usually teaches for another 6 weeks with the following online tools used by the teachers and students: Google Docs, Excel, and Scratch. Ms. Moore commented that she spent a large amount of time on Google Docs, teaching students how to share documents, attach documents to e-mail, comment and reply on various documents to an individual or group, and more. This is the skill for communication in the digital society. This year, the District has provided an e-mail account for each student, as mentioned earlier, in addition to several Google applications for use in school, for example, Google Docs, Google Sites, Google Calendar, Google Contacts, and Picasa web albums. Thus, students are able to learn more about the potential of using e-mail communication and Google document sharing besides the texting they seem to do every day. As confirmation of their comfort with these tools, some students would even send Ms. Moore an e-mail if they had any questions. Ms. Moore also talked about how she would like to teach students about long distance communication and learning, with the possibility of a partner in a different class location in the near future.

This year, Ms. Moore also taught a program, “Glogster,” which allows the users to make an animated poster with music and information linked directly to the websites. She pointed out that there are many forms of technology accessible to students out there that are integrated into students’ day-to-day lives, for example, the smartphone. Last year, Ms. Moore taught about how to use several gadgets and applications on the smartphone, such as how to make QR codes. But there are a number of students who do not examine the additional facets of these tools. Ms. Moore showed students many things they can do besides texting, checking Facebook, or watching YouTube on the phone.

The technology class curriculum could be different from one year to another, depending on the technologies at hand and students’ needs. Ms. Moore chose to teach what she believed would be best for the students at that particular time. When I asked her how she planned her curriculum, she spoke about how she looks at the state as well as national standards to match what are the best of these guidelines that she can then bring to the students. She enjoys reading technology magazines, and these materials provide her insight into what is out there in the real world and what might be useful for students.

She also attends conferences to learn other educators' suggestions in teaching and learning, as well as stays current with ever-changing trends. Ms. Moore emphasizes her primary choice is more about what is best for this age of students and what would be useful to enhance their learning not only in this class but also for other classes. Of course, trying to anticipate the most up-to-date tools the students might use in the near future is also very important to her work.

Then, when I asked Ms. Moore how she came to choose to teach the Scratch program, her eyes shone, and she talked about her computer language learning experience when she was in college. She definitely loves digital technology, and all these experiences brought her a unique view for seeing technology in education. Ms. Moore shared with me the lesson offered when she studied mathematics to fulfill the credentials she needed for teaching elementary school: One of her teachers taught the computer language, LOGO, but the class was designed to help teachers understand how to teach math instead of how students understand it. From this, Ms. Moore learned how to see math in a different environment and subsequently how to use her math skills and those she would share with her students in the real world. For example, when she taught in California, she helped students understand various geometric forms in the digital environment. Then, 3 years ago, a colleague of Ms. Moore mentioned to her about Scratch and after her first exposure, she knew it would be a useful program to intensify students' view of the computer's possibilities through the practices it shares and teaches.

Scratch is designed to help students understand computing thinking and animation in the digital environment. Ms. Moore referred to this as logical processing. She explained, "If I do this, then this results. Get the order right and get the word right."

Putting the math sentences together in the right order then creates an animation. Again, making an animation work properly is also based on attention to details. The player focuses on exactly what the game maker plans. For any step, this is no different than working in language arts class building an essay, or trying to back up a proof in science class. In learning in the Scratch environment, students are forced to pay attention to thinking clearly about what needs to be done, step by step. Ms. Moore continued her explanation: "However, students also learn to think simultaneously of many things instead of doing one simple action in Scratch." Students needed to consider several possibilities for interaction between sprites, sprites' transition to the different backgrounds, and so on. This again brings Ms. Moore back to her commitment to both planning and multitasking.

The method Ms. Moore uses for teaching is based on communication and explanation. She always made sure she presented clear introductions for projects, or any other activities. Students needed to have a clear plan and understanding for their individual project and be able to speak about it. Sometimes, if a student wanted to share his/her thoughts about his/her work with Ms. Moore, she would encourage this specific student to speak of these thoughts aloud several times to make sure that was what he/she wanted to do. The learning starts in communication. When students are capable of explaining their thoughts, they understand the objective of each project and work step by step toward this direction.

Ms. Moore expressed how critical the working process is rather than having a project done in 3 weeks. The process in learning propels students to obtain the knowledge they deserve in the learning experience. Ms. Moore commented,

> If there is any time I need to slow down, and with each student confirm the concept is understood, I would do it. If students showed coherent understanding in a step, I would speed the learning schedule. So the time is flexible each day.

Meanwhile, if there were any student who already knew a certain subject, Ms. Moore would make sure he/she was not slowed down by the learning exercise needed by the rest of the class. In this regard, she explained that there is usually a minimum requirement but no maximum in her assignments. She expects students to pursue their goals as far as they want, instead of telling students, “You have done enough, and you can stop; or, can you wait for other students to be ready?”

Ms. Moore has taught Scratch as a project-based learning exercise for 3 years. She commented that one reason she enjoys teaching technology is that even if she keeps the same curriculum, she finds it fascinating that students usually have their own unique plan for their projects and how they interpret them. She conveyed, “I like to listen to students’ plans for their project and watch how the students solve the problems based on the individuals’ intentions and scheme.” Learning in the digital environment is not one-way teaching and listening.

Every day, Ms. Moore walked around the class and spoke with individual students as much as possible. She sought to see the unique needs of her individual students. Speaking further about her teaching method and the program, Scratch, she said,

> I do find a complication of Scratch is because there are many things you can do in this program as different from if I just stood by the SMART Board and taught the program, and let students work on their project later. These students would not remember what I just taught and that is not progressive.

Learning by doing, with the necessary instructions from the teacher, supplements and strengthens students’ required learning.

While discussing the challenges in her teaching, Ms. Moore talked about her commitment to be a good teacher and support her students in whatever ways she can. Family issues are always critical in regard to her teaching. Some students may bring strengths, challenges, and emotions from their home to school. For example, parents' divorce, family loss, or parents' strict wishes according to custom or culture all play a role. Sometimes, parents would ask if their children did not get to learn keyboard typing. In this regard, Ms. Moore commented, "Students actually should know about typing before entering the middle school. We do not have much time for fundamental things like this. There are a number of things students need to learn in this age." My understanding from the students is that some of them only began to use computers to produce a PowerPoint presentation when they were in 3rd grade, before enrolling in middle school—a gap of several years. Other students did not use the computer at all in elementary school. Ms. Moore expressed her strong wish that students would learn more about typing or basic computer skills before beginning middle school study. She reflected,

> I do hope students can learn how to type earlier, so they can be proficient when they type for their essay or research here. Again, I think it is important to learn when the age is appropriate for that task.

Technology is everywhere. Many children have accessed many technologies from a very early age. Ms. Moore also talked about the issue of safety. Although students acquire skill in computers, they need to be aware of how to be safe in the digital environment. There are an increasing number of students who grow up with computers and mobile phones, and they need to learn more about the best practices of their general use. Ms. Moore stressed how much she hopes she can show her students, but digital media and the learning of technologies cannot be imparted only in middle school or high school.

Ms. Moore surely cares about her students, and it is seen in her passion, commitment, and how very well she teaches. If she sees a student who does not want to learn or lacks respect for learning, she would prefer a deep "one-to-one" conversation with this student rather than let him/her continue from a perspective of negativity. Ms. Moore wants these students to reach and find the joy of learning.

Whether in her math or technology class, Ms. Moore would spend time explaining the strategy to a student if he/she had difficulty. Ms. Moore reflected, "Every individual is unique and has different pace and plan for his/her project. I hope each students has fun and wants to become more involved." Eventually, she hopes her students will think how they use these learning experiences, what other ways they can use them, and more. With these essentials, the full extent of learning is just beginning.

Ms. Moore also spoke about certain students' attitudes in learning and how they questioned her about why they have to learn certain subjects. In her words,

> My job is not to prepare you for a certain job, but things you might need to know. If you knew what you want to be when you are 35, 45, or 55 years old, we could have a discussion, and I would teach you these specific skills. Otherwise, I will teach you whatever I can, so you can choose to be whoever you want to be. My role is to prepare you for any possibility for your future.

Last but not the least, Ms. Moore had a strong hope that students would keep involved in what they had learned in her class; otherwise, they would forget about what they had learned. In this regard, she explained, "I hope my students would understand my teaching is not an isolated subject, and it can be used in many specifics of their life. They can see the benefit from it, and understand when they need it."

Evaluation

At the end of the maze game and final project, students got a chance to play other students' games during one or two class periods. For the final project, Ms. Moore prepared an evaluation form for students' comments on the game they played. There were seven "yes" and "no" questions and two reflection questions, as follows:

- Did the activity have sound?
- Did it start by clicking the green flag?
- Was there an introduction?
- Was there a conclusion with the author's signature?
- Did the activity ask you any questions and/or have a dialog with the player?
- Did you find the activity challenging?
- Did you find the activity worked well? If no, please describe what did not work well.
- What did you like best about this activity?
- How would you suggest improving in the activity? (Ms. Moore's *Scratch Project Evaluation,* 2012)

Basically, these questions served to helped determine if the game:

1. Was functioning well;
2. Provided a clear instruction and conclusion for the players;
3. Provided any interaction between the game maker and the player;
4. Gave any evidence of joy while playing.

Communication is significant in Ms. Moore's teaching and key to learning through making video games. Further, the skill of communicating and commenting on other people's work is also important to being a digital citizen as well as a receiver and giver of knowledge.

Engagement

An element of engagement, in the context of this study, is seen in the students' genuine enjoyment in learning experiences. Occasionally, it can be observed that some students sit in class only because they are told to be there. That is not engagement. If a student finds a subject interesting and wants to pursue it to achieve success in a particular goal, he/she will keep working on it and will ask several questions. That is exciting and demonstrates a joy for learning. This student definitely is engaged in learning.

Ms. Moore expounded further on engagement: “I really appreciate to see how hard working this group was. There was not any student saying it was too hard and wanting to give up.” Engagement, for Ms. Moore, is embodied in watching this group of students. When she recognized the strengths of this group of students, she pushed them to apply more effort to their work; but students still had fun and worked harder and without complaint. Ms. Moore expressed that this is the work ethic that students sometimes miss. For example, some students do not do homework and complain how boring it is. Such students do not realize the exhilaration that comes with a hardworking attitude and the resulting success.

One subject of concern in education is about how educators help students better engage with the many formal and informal learning experiences of the classroom and life. Ms. Moore’s teaching method speaks to how she engages students’ inherent learning attitudes. She normally tries to communicate with any student who has lost interest in learning and tries to make him/her feel more comfortable with him/herself. She wants to make sure to learn how her teaching could be different to make this specific student want to be part of the class and learning as a whole concept. The student would then be comfortable enough to do each thing a little bit harder, step by step, and with greater commitment.

Students chose to take the technology course but were usually forced to take a math class. Ms. Moore also talked about how she uses technologies to engage her students' learning in her required math class. Since Ms. Moore received a grant for purchasing 10 laptops for her math classroom, students have become more regularly exposed to the digital environment in that class. However, there are always a number of students who try to escape the digital environment from the beginning. Ms. Moore usually tries to first help students feel comfortable with the learning experience. Nonetheless, she has sometimes forced students to work on the computer. She pointed out, "Maybe the students' math skill is very low, so they ignore doing things related to math. But, eventually students feel comfortable and want to use computers for study." Whether in her math or technology class, Ms. Moore does not rush students to reach a certain goal as long as they feel safe and comfortable to learn with supporting tools, such as computers.

Creativity

Ms. Moore spoke about her views on creativity, which are more about exploration: "Creativity is taught by guidance accompanied by freedom. Students are encouraged to create their wants, free of judgment or things that might make them nervous." If a student always works based on what a teacher has taught him/her to do, creativity cannot be broadened.

I clearly observed Ms. Moore's technique to help students' creativity bloom. During the 6 weeks of the Scratch project, she introduced them to the field of making video games and talked to them about what they could do with it, what would be a practical benefit from it, and more. Ms. Moore helped students be involved and think about the digital games they played and their own games. The encouragement from Ms. Moore of playing video games was also a strategy to inspire students to think. She reminded students to see what other people have done with their video games, what they like, and what they do not like. Further, students were encouraged to think what they can do and what they want to do for their own games. This was the freedom Ms. Moore always talked about. Students were free to explore whatever was in their mind and add their special touch to individual projects.

In this class, I observed that many students liked to use their own drawings and handwriting for their games. There was a student who drew fish, octopus, and a house for his game, whereas a girl drew her own owls as the main characters in her games. This student shared with me how much she loved owls and wanted to make her game special. I was also surprised to see another student's imagination used to combine castles, armies, and helicopters in his game. Other students drew by hand for their game; for example, I saw a jungle, two lollipops, and more. Students presented their own style choices for their drawings, and they were all very original. And, while I was walking around to observe students' work, I kept asking what made them choose their own drawing instead of the icons on the Scratch website.

There were many students who wrote out "start" and "exit" for their maze game, as well as the title for their third game, instead of using the computer fonts and text, adding more personal attachment to their work. Because Ms. Moore did not require adherence to any specific direction, I was glad to see students' own thoughts for their game characters and text. Near the end of the students' third project, one student came up with an idea that animated his name; it was written down one stroke at a time on the last screen, like the credits in a movie. Other students wanted to do this, once they saw the student's effort and result.

Talking about sound and music for their games, most students wanted to add this feature once they heard about it. In the paths for the maze games, every student had his/her own layout, from the style of the South Park cartoon to complicated diagonal lines with a beach theme. Each student worked hard to be different from others' work.

One girl student shared her game with me. She had decided to do a game resembling a carnival and wanted it to be fun, like actually playing in a carnival. She thought about themes for each of the two levels: a sunglasses bouncing game for level one and a maze game for level two. Next, she thought about a theme for the game for level three, such as "guess a riddle." What complex thinking and scheme for a game! To fulfill her wishes, this student wanted to do a singular game, and she kept thinking in what ways she could push it to the goal she envisioned. It was evident this student enjoyed the game making project and used her imagination as the premier element of her games, when possible.

There was a boy student who worked on his game based on a football theme. I assumed he was a football fan. The player was the football player in the game, and he needed to hit the moving target by throwing his ball. In order to do this, the player needed to move the cursor with the mouse and hit the target with the space bar. There were eight levels, and the more complicated the game activity, the higher the level reached by the player. I surmised that it was a complicated scheme for the simple action of throwing a ball to a moving target. This student figured out the coding within his completed presentation, and whoever played his game would be proud of his endeavor.

Each student is unique. In this class, students even worked hard to be different from each other. Ms. Moore observed that students in this class had not done any work similar to that of another person. Ms. Moore commented this was probably because she did not set any limitations on her students as to what they should do with their game. Students had the option to pursue what they wanted from their own game.

Students' Response

Amy. Amy is a typical American girl with dark-brown-colored hair. She did not talk much during the class but always focused on her work on the computer. I noticed she would look at her computer screen with a frown when she was concentrating. Obviously she thinks a great deal, which was evident in her own game. In the final project, Amy made three different games for a carnival theme park. She thought about her projects and worked on them constantly after she installed the Scratch program on her personal laptop at home. Amy is an exceptional student, always engaged in a school activity. When Ms. Moore asked for a volunteer to watch the time or provide any reminders, Amy always raised her hand to offer her help. Once in a while, when other friends in the class asked her for aid, she would walk over to help. Near the end of the trimester, when Ms. Moore asked students who would like to be involved in my research study, Amy raised her hand without hesitation. Here, in her own words, is Amy's statement:

> This project is about creating games with Scratch
> Using different sprites and blocks for something
> Mine is carnival game
> I wanted to make a real fun game
> My 9-years-old sister talked with me about Disneyland
> Then I thought about carnival
> Many fun games to go with carnival
> I am glad I learned Scratch
> I can make games

I can be proficient with technology

I did not know what we would do for this class
I knew we would learn something about computer
I use computer at home
Playing on-line game most time
I have a Facebook account
Wanted to check it all the time when I got it
Not anymore now
The schoolwork and sport keep me very busy

A lot of assignment on-line from my teachers
I do not say I like doing homework
But I like to do homework on the computer
A lot of typing on computer
Download pictures and insert them to my homework

I like language art and I like typing
I have a folder on my laptop
Full of my typed stories
However, I am not a fast typist
I only learned it two weeks in 5th grade
Never touch the basic again
Some day, I want to type faster

Compared with working on pen and paper
Slow process
If you want to change anything
You have to re-write it
Working on the computer
Click the button and change the ways you want
Using computer is faster than pen and paper

When I was about 7 or 8
My mom got a brand new laptop
I was so excited
Wanted to use it almost every day
I played around, typed on it almost every day
I want to be involved with it more everyday

This is actually the first technology class for me
I did not do much computer work in the elementary school

When I was thinking about my project
I did not want to do a simple game

Maybe I have ambition and want to make something fun
I do have fun with Scratch
I download it on my computer
So, work on it anytime I want
I have ambition and I want to make it excellent
When my friends asked me why I wanted to do so much
I said, it is a lot fun

When I first started
I could not make things work
Something just not right the way I wanted
So there were a couple times
Wanted to stop, just
But I came out, this game got me interested again

I like this project a lot
I do not say I love it
There were some times really difficult to deal with
I put a lot of time making it working the way I want

With the action that did not do what it's supposed to do
I need to take time and think what I need to do
Check everything, again and again

If I just cannot figure it out
I asked the teacher for tips
If I still cannot figure it out
I just had to switch them differently

The choice
I like the computer the best
There are so many things I can do on it
Typing is much easier
And I can organize files nice

I discussed with the teacher almost everyday
Sometimes I just did not need help, focus on my own
I knew what to do
I did not need any help or ask any questions
I let my friends play my game
Making sure it's not only fun but challenging enough

Once I complete this final carnival
I will e-mail it back home
I want my sister to play it

She was the one who helped me getting the idea
I told her about it, a few times
I know she wants to play it
My mom is interested too

I e-mail myself a lot
I e-mail my work to myself a lot
I wrote down what I wanted to do that weekend on e-mail
If I was confused with something I wanted to do, I drew
I do not think I am a good artist, but a visual person
A drawing showed me what I wanted to go here or there or turn
Very handy
Then I send them to myself on e-mail

Use a flash drive, sometimes
But, might be virus in it
With the e-mail, Much easier

When I am home
If I have any question for my homework
I would type it out and e-mail it to my teachers too

The teacher started teaching by introducing the project
Along the way,
Gave us the hints about what to do
She walked around to help us all the time
If many people had similar questions
She would stop us and start teaching about it
She let us work after the regular class
So we can work on it more
Also
The private attention
Helps us a lot
Since I picked up such a big project
I needed the extra time and help

A typical day
I came in
I checked e-mail and calendar
What we're supposed to do each day
Then I tried to get as much of my work done as I could

Four weeks is just a good amount of time
I like it so much
So I work on it at home too

Many students only work in the class

If I have more time
I want to do more games
It might affect my experience a little bit more
But for now
It is just right and good
I have learned so much while doing it

I definitely learned a lot about computer
Like e-mail, Google Doc
A lot of communication stuff
Like the calendar we look at every day
I learned to use the computer different than the way I did before
Although being a kid these days
I am still confused on how to do the certain things
But in this class
I certainly learned how to be better on the computer

I think my friends have learned the same things I learned
How to get better use with the computer
I think a lot of my friends like to use computer too
I do not think of any one who do not like it
Because we are computer kids nowadays
Amazing
Always be better and better use with these new coming stuffs
We are always on the computer
And it is a lot of fun

Like my good friend and I
We like to do homework on the computer
Because it is fun
Just like to be on the computer overall

I have a mobile phone
I text my friends all the time
But it is more about homework
Once when we were working on a science project
Friends and I texted each other for questions
My mom said, "Why don't you just call your friends?"
I said just because texting is easier
She said, "Phone call is quick"
But I just text, I cannot change

This project is almost completed

I like the feeling something is completed
I like this experience and be able to finish it
Create my own game and have it done
Just like awesome in my mind
I am like that kind of people
"Yes! I made it!"

I play soccer
Sometimes I watch soccer video on YouTube
Watch what other professionals do
I do a lot of stuff on-line that helps me to be better at what I do

Kids are very technology based now
We use mobile phone, laptop, iPad, all these technologies
I need to say kids are very technology based
These days in this age

Amy showed she enjoyed great experiences with digital media technology and this class. She believed the children in her generation are digital kids, and they like to use digital technology, such as laptops, mobile phones, iPad, or iPod all the time. She agreed this class helped her to understand more about what digital technology can do for her and has provided many communication tips, including Google applications and e-mail. Amy is a hard worker and an ambitious person. She has motivation that encourages her to keep learning and pursue her goals via best work. She also talked about how much she wanted to show her projects to her sister and mother. She was very proud of her engagement with this class.

John. John's game was about an octopus that wanted to go back to his cave. In order to do this, the player needed to help the octopus combat several levels of battle to reach this destination. John told me that his father works as a manager in an IT department, and he hopes he can work on a complicated game with his father in the future. Here, in his own words, is John's statement:

My game is about an octopus wanting to go back to his cave
You need to get through different levels to be in the destination
If you touched the bad guys
You need to re-start from level one

I saw some other people's game
I found one—I really like it
Thought about doing something similar
Only take one class period to think
The game I want to do

In the beginning
I thought, learned about computer
But I didn't know I would learn to make games
And it is actually a lot of fun

Last time, technology in class, 3rd grade
For some reason
The teachers taught us to do a Power Point presentation

I use computer at home, sometimes, for the homework
I go on Facebook, sometimes
E-mail, sometimes
Play games, only when I was bored
My sister is on there every day, 24/7
She is in high school

There is a lot I want to learn
I don't use computer that often
A good opportunity, in this class
The teacher taught me a lot
I understand a lot more

Before
I know the computer
But I didn't know there is a lot I can do
Now
I know I can do
Things like import objects, from web to my own
Making fun games
Share documents
And more
I didn't know how to do all these before
I know I can do all now

Hope to learn to be able to use computer more
Use stuff more proficiently
More developing

I like to use the computer, a lot
Drawing on the computer is a lot of fun
I am not very good with art
But drawing and art, on the computer, much fun

My favorite subject is math and science
But
I didn't know I use math for making games

The challenge definitely
How I figure out, use things on the computer
Making game projects
Different and new to me
However
Keep working on it
While doing something new
Need to spend a little bit longer time
Figure out the way
Ask friends for help too

Start to feel comfortable with it

Seeing example helping me to think
I start thinking something
Something random
Then a bunch of words in my head
Eventually ideas, pop out

There were a few times I lost interest
While working
Confusing
Frustrated
So, a little bit break
See what other people were doing
Maybe I can help them, a little bit
Eventually
They can help me, something
Or I would sit for a minute or two
To think instead of work on it
Felt better
There were times I really lost interest

Felt frustrated
Otherwise
I am very interested in
What we do in the class
I did not lose interest that long, usually

I talked with friends in the class
We talk about what we do
I want to talk with my dad too
He has a lot to do with computers
For example
When I do homework at home
If I need any help
I go to talk with him
He knows a lot
He knows a lot about computer too

I don't want to be late to the class, morning
When I get to the school
The computer is the first thing I turn on, usually
I just want to get on the computer
To see what we need to do, for that day
The teacher has a calendar
So we know what we need to do
That is what I like to do
To know what I am supposing to be doing

The teacher is very good for teaching this class
She explains the project ahead
If anyone is confused with something
She would come to talk with you
Very helpful, whenever
She is a good teacher

I might take technology class next year
It has been very helpful
I've seen some 8th graders' work
Pretty sure they did 3D building, Photoshop stuff
All very cool

I feel like I can use time, a little bit more time
For completing it better
I fixed some problems
Feel fine with it
I know I can make it better

Only need to get sound now

I definitely learned different ways, got things to the places
For example
How to put things together for a poster
I didn't know we can do it on the computer
I learned to use Microsoft
I know Google a lot better now
I didn't use that often
Now I know a bunch more

I didn't know Scratch before
It was very new to me
But it's very helpful to know it
Fun to work it
It's confusing, some part
But
Definitely, a good learning experience

I think my friends have learned about the same
A lot of them went to the same school like me
We didn't use the computer that often
We didn't know much
I know there are always some kids, know more than others
But a lot of them learned the same like me

I think it would be helpful
If I knew the computer earlier
We didn't use the computer that much
Here we use the computer, often
Homework is on it
I hope elementary school would help us a little bit more
Since we use so many now

It's meaningful
Because I feel more confident
With the computer now
Before
I would worry if I save correctly
But now
I feel confidence since I can do many things, correctly
How to sign off the computer instead of just push button to turn off
I am pretty proud of what I can do now

The computer, takes more time

I am not a faster typist
But I like how computer can make things precise and correct
Read each letter nicely
Editing change, easily
Size, font, or any style

For drawing
I like to draw by hand better
I can control better
But I like both really

I used to read comic books
We made comic book layout here
I would choose to read comic books on the laptop or iPad
Because carrying around books, annoying

Creativity
Something comes on your own
Original
Something you made
Let your mind free
Do whatever you want
Create something wiki
It is creative

Based on John's statement, he did not know much about computer technology beforehand, and this class guided him to progress well beyond what he had imagined. With this class, he achieved more confidence approaching technology. John also hoped there would be an opportunity to learn more about technology before entering high school**.** In the meantime, John made a comparison in his homework and day-to-day life between using and not using the computer, and appreciated how the computer made life much easier in such areas as typing, drawing, and reading on the iPad, as opposed to having to carry books. Further, John showed his gratitude to be in the class and never wanted to be late. He hoped one day he could work on some projects related to digital technology with his father. With this in mind, he knew he needed to keep learning.

Jennifer. When Ms. Moore announced to the class about my research study and that I would like to talk with several students about their learning with technology, Jennifer immediately sent an e-mail to Ms. Moore about her wanting to volunteer. According to Jennifer, her parents would get her a new iPad if she could make a game for the iPad. After she and I had our first conversation, I shared an application that allows people to make a game on the iPad. I wonder if Jennifer made a game for the iPad. In the interview, Jennifer shared some of her thoughts and experiences regarding game making, her joy in using the computer, and more. Here, in her own words, is Jennifer's statement:

> I drew my own characters, owls
> I made the eyes big and different colored owls
> Because I really like owls
> I saw one in my backyard, few days ago
> I wanted to incorporate them, to my game
>
> I also wanted to do something, adventure
> When I thought about it
> Thought about escaping bad guys
> Like fox, wolf, in the forest
> That was how I chose for bad guys
>
> I also added cookies
> Because I like cookies
> One of my younger brothers likes cookies too
> All how I got the idea for my game
>
> For this class
> I did not know I would learn to make games
> I thought this class would be a lot of fun
> Give me a lot of experience, deeper, idea, for the computer
> But I didn't know I would learn to make games
> That was a lot of fun
>
> But
> I really want to learn to make an iPad app
> As my dad told me
> If I can make an iPad app
> He would give me a new iPad

My father is a computer geek
So I want to learn more about it
I can teach him something
Instead he teaches me something

I use computer for science homework
Because the teacher put things there
Sometimes, I type for the homework
Otherwise
My computer is for having fun, at home
I like playing games on the computer

I use computer, sometimes
Sometimes not very much
Yesterday I was very busy, didn't use it at all
Today, I am not very busy after school
So I might use it
My brother doesn't like to play with me
So the computer is my new brother
I have two brothers, one is 9 and one is 7
We do not play video games together

My technology skill, definitely improved
But I know I am not the master, yet
Learned the basic
But the computer is a lot of fun
I want to learn more

Working on the pen and paper, a lot easier
Because that's what you do, most of the time
When you work on the computer
A lot of difference
Less control, because of the mouse
Not easy, compared with pen and paper

I think working with fingers is a little bit easier
On the iPad
Because it's more about your finger as your pen
While using the mouse, you need the whole hand, hold it
I like to use pen or finger, a lot of control

I read on iPad, sometimes
Not really fun
I like to read on the books, actually
I like the feeling of texture, on the book

Books are books
When they are on iPad, not the same
I like books better
Hard to explain, it's weird
I like iPad too
Small
As bring the whole bookshelf
Wherever you go

My favorite thing, in the class
Walking around, trying other friends; games
Finished products
Something your peers have done
Not professional yet
But cool to see the differences and similarities

We are not as professionals
But we still made pretty good games
I like to see what peers came out
It's our peers and they know what we like

Challenge
The programming part
Took really long time
Doing the same thing over and over, repeating
I like designing
The characters that I want to put in
Thinking
The idea I want to do
More fun

Sometimes
I go to Google
Look at the pictures or cartoons
Give me ideas
What I can design my game
Research on Google
Pleasure

Didn't take very long
Think of the game I was going to do
Because I keep thinking about it
Because I really want to make it
So I thought about it, often

I like to use computer
Maybe a lot
I know there is a lot of things I want to do
I want to do things with my brothers too

Using the computer for my homework
Make sure I save
Otherwise
I would be very mad, to myself
Worked for hours if I forgot to save
I would make sure spell checking on my own
Instead of doing spell checking on Word
Of course
I want to improve how fast I can type

I like writing
I think I can be creative with it
But do not like the school report
It’s informational
I like just to be free, for my writing
Fairytale and fantasy

I’ve not seen any friends of mine
Who doesn’t like to use a computer
My friends all enjoy it

I have a cell phone
Use it a lot
Because I don’t have Facebook
Nobody writes anymore
Friends go to different schools
Not all of my friends have e-mail
We text a lot to keep in touch

I learned
How to set up a document
The project in the very beginning
I also learned
How hard it is to program a game, it can be
But designing the characters is a lot of fun
Sometimes
Thinking what they can do, fun
I learned a lot what to do with the computer, actually
Fun

I think my friends learned the same things
Before this class
Did not know much
It is our first computer class
In elementary
We didn’t really have a computer class
We learned Word a while ago
But didn’t really have a class learning about technology
Making a game, never came to my mind

My brothers know the basic Word
At home computer, just got virus
Otherwise
I hope I can download Scratch
Teach them to do some simple games

To me
It’s very cool that I can make a game, to have it work
My peers can enjoy the game I made
I am proud of it
Meaningful to me
Will stick with me for a while
Because making a game, a lot of fun
It was a different experience than what we’re used to
Most people don’t know how to make games on the computer

I am happy

Jennifer was definitely happy about her learning experience with digital technology. She had no clue what she would learn in this class, having only a hint to lead her to experience more about the computer. Although Jennifer favored designing characters and planning the game instead of programming study, she found many exciting lessons in this class. She liked to use digital equipment for tasks, such as typing on the computer, but she still enjoyed the hands-on feeling of drawing by hand or holding a book. But it was very interesting that Jennifer mentioned her favorite element of the iPad was the finger touch control. There is no doubt that she loved to work on the computer, because it motivated her to approach more and diverse uses with digital technologies.

Will. In Will's game, he prepared 23 questions for the players. Will mentioned that he has not seen anyone who made a game similar to his, so he felt how special it was. Will described his thoughts, interest, and enthusiasm for game making and his use of technology. Here, in his own words, is Will's statement:

> My game is about a secret passage for different questions
> As passing through different questions
> Accept different tasks
> There are 23 questions
> Go through
>
> They are like a riddle game
> People usually
> Overthink their questions
> That's what this game's about
> Try not to overthink
> Then
> You would get your answer right
>
> I've seen the game similar to this game I made
> I really like this game
>
> I didn't know I would learn to make games
> I think the curriculum is different every trimester
> So
> I really didn't know what I would learn
> But I know
> I want to learn more about technology
>
> I didn't learn much about computer
> In the elementary school
> I hope I learned much, while younger
>
> My family is not, computer-type family
> But I like it all the time
> I use computer a lot
> I try to experience what I can
> How I can use more

I play games a lot
Almost 12 hours a week, on my iPod touch
Comfortable to work with my fingers
Listen to music

I hope to learn, build more games
Build them more difficult
Complicated games
One day

While doing the game
I like to think, idea
Think what I can do
Start building it
Keep building it

I've never lost interest
While building the game
I
Enjoy making games
Working on the computer
Hope I can make more good games

My favorite thing
Be here with everybody
Creating a game, was fun

When I have a hard time, apply what I want to do
I tweak it in different ways
Make sure it could be what I want
But if it's really not very good
I would leave it that way

If I have longer time for my game
I would make it much longer
Originally
I wanted to make 110 questions

Time affects my learning
Only about one hour each day
Not really enough time for me
Complete a game in 3 or 4 weeks
If I had longer time
I would create a longer game

First
I learned basic, making game
Then
I learned to build ideas, out of thinking
Thinking and put them on the computer

I think my friends learn the same things, like I do
How to build a game
Apply the idea into the game
I've not seen any friends of mine
Don't like to use the computer

I am proud I completed the project
With what I wanted
Able to create something
From the idea I had
Enjoy

My project means a lot to me
I like to play games
Now I can make games
I learned Scratch, and I made it

I am very happy about my work
I want to learn
Make more complicated games

Working on the computer, much easier
Don't need to care about writing
In the math class
We use computer for the test
The rest, we use for typing the assignments
I like we can do a lot more on the computer here

According to Will's statement, he was very excited about his game project and its completion. He talked about how much he loved to play video games, and the ability to make a game was a source of real pride for him. He never lost interest during the class and was eager to make a longer game if he had more time.

Behind the Scenes

Just before the trimester ended, Ms. Moore shared with me that the 7th grade technology class would not be taught next year. Ms. Moore said, "I am not happy about it. Unfortunately with the way the budget cuts are, there is nothing I can do about it. It is just not the priority for the school." However, she also expressed the belief that her school would only suffer from these cuts for a short period, and students would soon again learn technology in 7th grade. It was unfortunate news, especially because students had just told me how much they hoped technology classes would be offered at a younger age. Even with Ms. Moore's desire to teach these students more about technology, there is not much that can be done with a lack of resources.

Ms. Wood, Technology Teacher

Ms. Wood is from Wisconsin and has taught in the Vista Heights Middle School for 10 years. This school has an enrollment of over 800 students in the 7th- and 8th-grade programs. Vista Heights Middle School's website homepage indicates that the school is noted for its outstanding technology program and the fact that students use technology in every class—from art to vocal music and for a variety of purposes. The ratio of computer use in the school is one computer for every 2.5 students. Students are required to take technology classes in 7th grade, and there are two part-time and one fulltime technology teachers in the school. Ms. Wood teaches art, 8th grade technology, and gifted programs, and she has remarked that she finds many personal and professional rewards using technology in her work.

Before Ms. Wood joined Vista Heights Middle School, she taught elementary school art in Wisconsin for 4½ years and worked on her master's degree in English as a second language. Ms. Wood has her bachelor degree in art education. Currently, she is also working on her doctoral degree in educational leadership in technology. In the classroom, she places emphasis on the issue of sustainability and how to help students understand the basics of sustainability in design-based learning. Ms. Wood commented that her goal is to provide a practical teaching experience, using the current theories of educational scholars and applying them to actual practice in the classroom.

Immediately after receiving her bachelor degree, Ms. Wood taught in Kaohsiung, Taiwan for 2½ years. She also worked in Adelaide, Australia as an exchange teacher in 2007. Ms. Wood shared with me that whereas her teaching experience in Australia consisted of art classes, she focused on digital art and used software, such as Adobe Photoshop, Illustrator, and Flash. She also used technology for teaching Australian history. In this regard, she commented that it was the first time she had tried to use technology to teach subjects with methods not specifically designed for technology use in the classroom.

Ms. Wood is in her mid 30s, White, and married with one baby daughter, whose picture is incorporated into a yearly calendar posted on the wall by her desk. She talked about her daughter with me, and it was apparent how grateful she is being a mother. In the classroom, Ms. Wood is like a mother to her students. She tries to get to know each student and memorizes individuals' names every trimester. Frequently she checks with students about their work, ranging from their current project to their plans for next year. If necessary, she will also call the students' parents for further discussion to incorporate the whole family into the learning process.

In the 8th technology class that I chose to observe for my research, Ms. Wood taught animation in Adobe Flash and iMovie, 3D architecture in Sketch-up, and game making in Scratch. I focused my study on Ms. Wood's Scratch teaching and learning. In this period, students learned to make two game projects, using Scratch. The first project consisted of making a maze game, which students completed in a 10-day period. The second was called a game design project. Ms. Wood's goal was to challenge the audience/user to think differently about a topic. She listed the possible topic choices: making a game where (a) the objective is education about a topic, (b) the main player is not a "good guy," (c) the consequences of a choice are demonstrated, and (d) there is no clear winner.

I observed Ms. Wood and her technology class 55 minutes every day, from the beginning to the end of February 2012. I interviewed Ms. Moore and the four chosen students the last week of that month. There were 21 students in the class, all of whom were White Americans. There were six girls in the class. The following description of Ms. Moore and her class are organized into six sections: the classroom experience, the teacher's approach, engagement, creativity, students' response, and observations from behind the scenes. These provide a thorough depiction of how the teaching and learning is done in Ms. Moore's technology class at a middle school in suburban Denver, Colorado.

The Classroom Experience

Ms. Wood spoke to the students, "Everyone meet at the big table please." There was a big table in the classroom where Ms. Wood kept students together to facilitate their attention. For example, any presentation on the SMART Board in the front of the classroom or any announcement for a specific school or class agenda suggested that the "big table" was a useful tool to ensure students' focus and attention to the subject at hand. This particular occasion was the day Ms. Wood was going to announce a new project: the Scratch game-making project. After a brief introduction, she went on to show, step by step, some simple movements on the SMART Board. During this time, students responded naturally to her questions as if they were high-tech engineers and ready for any task. Next, some students went on to open the Scratch program, while others still needed to wrap up the previous 3D house drawing used in the sustainability concept project. However, many students could not wait to use Scratch for making animation.

Ms. Wood had to keep reminding some of the students to work in stages, adding, "I will show you how to do this movement whenever you have your house finished." One student went onto Scratch instead of finishing his previous project and soon began to encounter the stress of learning a new tool. To this, Ms. Wood responded, "Jerry, that is why you are behind on your work. You need to complete your current project." I wondered what this student's impression was, transitioning from 3D modeling to a game-making project.

It was my understanding that there were only about three students who had used the Scratch program before, and it was the first time Ms. Wood had taught Scratch to this group. Consequently, she received many questions, such as "Ms. Wood, how can I change the color?" and "Ms. Wood, how can I import art work to Scratch?"

Students could not wait to let their hands and imagination play around with Scratch. Ms. Wood reminded them of some tools they had learned in the program Photoshop: "Do you remember what we learned in Photoshop. They are similar strategies." Apparently, students were familiar with Photoshop. Ms. Wood cheered students on to feel free to use Photoshop or Paint for drawing if it would be easier. However, some students seemingly were not afraid of approaching the new software and worked on Scratch without much hesitation.

Ms. Wood worked on the SMART Board, teaching about the x, y coordinates, which constitute the first concept of movement for the sprites on the stage, reminding students this was the same concept they had learned in math. She pointed to the block for coding in Scratch and asked the students, "What will change if you changed these numbers?" Students answered, "x and y location." It was obvious students understood the movement from one location to another, and it was also known that the results depend on how the statement is given to the computer. Thus, she explained, "It is not about what you want. The computer only does what you tell it to do." She emphasized the importance of writing a clear statement, a reflection of the precise nature of programming.

I assumed this was the first programming lesson for the students. Making a video game stresses learning programming. To create an animation the way the game maker wants, he/she needs to make a clear step-by-step statement in coding for the computer to understand it. Ms. Wood wanted students to feel comfortable with the basic concept of movement. With this in mind, she chose to have students learn to make a maze game for the first step.

On the smaller whiteboard on the side of the classroom, Ms. Wood wrote down key schemes for this project: (a) learning about Scratch, (b) how to learn about making games, and (c) what can you do to achieve what you want with Scratch. Ms. Wood depicted these basic schemes as follows:

A. What is Scratch	1. Learn basics
B. How	2. Create maze
C. When finished	3. Create final game

Several students started planning and drawing lines for their maze games, though others put their effort into character design. I observed that one girl sketched her maze game on paper before she brought it to the computer. Ms. Wood told me this student had been in her art class last year, and the sketch and process book were always required in that class. The student had established this habit for her work, which carried over to her present task. In this planning and drawing phase, some of the dialogue I heard included,

"Do you want to change the costume?"

"Do that again, it is so awesome!"

"Did you hit the green flag to restart the game."

"Joy, I got an idea for you!"

"You learned to do it without me to teach you. Nice!"

Many students raised their hand for Ms. Wood's help and comments on their process. She walked around the classroom to share her observations. Students learned from her hints. I could hear students speaking to her with excitement: "Ms. Wood, I figured out how to solve the problem on this movement;" and "Ms. Wood, check out this!"

By all accounts, students were actively engaged in learning everything they could, from the fundamental movement and importing of images to creation of the stage for the game on the program. Students were eager to explore what maze games they could create. From the corner where I was seated, I observed the energy from these individuals as they strived for the best they were capable of doing.

Near the end of the class period that day, I heard one student exclaim, “I should use GarageBand[23] for my music!” Evidently, this student was thinking well ahead for his game and went on to work on adding music to his game.

On Friday of one week, Ms. Wood had invited a professional game designer to talk with the students. When students came in, Ms. Wood asked them to sit by the big table. Some students showed grins on their faces, showing they must be excited for this experience.

The game designer began speaking about considerations in the game industry in the real world in relation to people, topics, stories, process, review, and more. Sometimes, the game designer asked students for questions, and they responded with their knowledge of the game industry or asked this expert for his comments about their thoughts, observations, and ideas. Students expressed their views on various aspects of game making, from the Scratch game they learned in class to work at the industry level. They contemplated how a simple-in-concept game proved to be complicated in execution. Then, students showed the game designer the maze games they were making.

Many middle school students have played numerous video games on the computer or other devices, such as the iPod or mobile phone. Ms. Wood told me that with their imaginations, students normally want to have many tasks in their games without

[23]GarageBand is a software application developed by Apple Inc. that allows users to create music (GarageBand’11, 2012).

first planning. The teacher's job is to guide them in the right direction. For example, one student showed Ms. Wood how he made his character fly while pushing the space bar. She said to him, "It is very cute, but it does not really fit for your maze game." However, she reminded him to keep this idea for the future. It is clear that students' enthusiasm for games often pushes them ahead of their learning, but the level of engagement was very high, evidenced by their commitment to acquiring the knowledge needed to make their games achieve their vision.

Because students of this age have usually experienced many different video games, many want to embrace something they have seen while playing these games or even something born in their imagination. Many in the class were determined to achieve the best work possible from the inspiration of these experiences. Once, I heard Ms. Wood cautioned the students,

> You have a very short time. Do you think you can finish this complicated idea?…What you want to do is too high level. If you finish your maze game, we can discuss the possibility of these ideas for the next game.

Again, this was clear proof of the students' positive connection with this process.

The day students turned in their maze games and started a new game project, Ms. Wood had them come to sit at the big table and gave them two sheets of paper: one green and one white. First, she and the students discussed their reflections about what they learned from the game designer's speech the previous Friday. Then she introduced the new project. The green sheet was a short summary about the new project, with several website links to the history of games, and examples and resources of games for the new project. Because Ms. Wood usually keeps her lesson plans on her website, students can easily go online to retrieve the information. The white sheet was for students to sketch out their plans for their own game. Afterwards, Ms. Wood had students play several of the games listed on the green sheet as well as on her website.

"Guys, I need your beautiful eyes here." Ms. Wood called for the students' attention to look at the game on the SMART Board. The first game was called Ayiti[24] – the cost of life. The purpose of this game is to teach students about topics ranging from human rights to education and the issue of poverty in the context of education. Besides learning about human rights, it is a game where there is no way the player can win. According to Ms. Wood, students usually get frustrated, but they still keep trying it. They are inspired and motivated by the game itself and derive a sense of "winning" from simply playing the game, though they soon learn actual winning is impossible. This is evidence of the "stickiness"—the strong attraction—of the computer. Ms. Wood told me that in order to win in this game, the player has to be very careful and make sure all movements and decision making are absolutely correct.

The second game was about climate change. The player would be the President of the European Nations and must tackle global climate change from 2000 to 2100. Some of the other games included a social impact game, the Food Force game[25], and more. Ms. Wood commented that individuals are quick to express criticism based on their opinions, but playing games helps to attain a balance from other perspectives. While playing games, individuals learn something, from knowledge of the content to the practice and

---

[24]Ayiti: The Cost of Life is a game funded by Microsoft and designed by Global Kids Paying 4 Keeps program (Ayiti: The Cost of Life, 2012).

[25]Food Force: This first humanitarian video game teaches children about the logistical challenges of delivering food aid in a major humanitarian crisis (Food Force, 2012).

process of the brain, and more. The assignment for that day was to keep playing these video games and plan for their own individual games with sketches.

It was Valentine's Day, but the weather was quite nice for mid-February. Many girl students dressed in pink t-shirts, and many of them were also hyperactive in the class. Because Ms. Wood always made an effort to remember individual students' names, she told a few students, by name, to calm down and find a balance in order to focus on classroom activity.

Several students started asking Ms. Wood for assistance on their games. When one student asked her for suggestions on his game, she directed him to talk with another student who sat in the back of the class. Ms. Wood told me that she uses the strategy of letting one student talk with another student who has a similar plan for his/her game. Eventually, students inspired each other and pushed each other to a finer and higher standard.

A student raised this question. "How can I make the color change?" Friends seated next to her heard her and helped with this question. In the opposite corner, several students watched a student playing a game. One student asked, "Is it your game?" The student who was playing responded, "It's Rick's game. Do you want to play it? It is not easy." There was no doubt students were excited about their games as well as this pink Valentine's Day.

I could hear Ms. Wood asking students, "What am I going to learn in your game?" This tactic reminded students of the purpose of the game they were making. As Ms. Wood commented earlier, students of this age tend to want to incorporate many tasks into one game and ignore the aim of their project. Thus she needed to remind them of the purpose of the assignment. Also, she pointed out that when students are playing games, they tend to focus on their practice as players. In spite of that, students need to reflect on what they can bring to their own work.

Meanwhile, Ms. Wood kept checking students to ensure their plans were in sketch on paper. She indicated that students normally put their thinking on paper easily, allowing them to see ahead what they want for their game. She believes it is a good habit to sketch down the idea before starting work on the computer. However, while putting all these plans into the program, the game maker needs to figure out how to tell the computer to do each task. This involves the learning of problem solving. Some students would make a very complicated game on paper, but it might also create a problem too complicated to solve on the computer at this stage of their learning. Balancing their ambition with this frustration was an important part of Ms. Wood's teaching.

On Ms. Wood's website, she also shared several other websites that helped solve some of the coding demands, for example, the website called iCODE[26]. I watched students, paired in teams, discuss the coding use on the website. For example, one student asked his/her partner, "Have you seem this?" Another enthusiastically commented, "I am going to try this." Then, Ms. Wood walked by. Immediately, the students stopped her and asked, "Ms. Wood, have you ever seen this?" Another student asked, "How can I do it?" Meanwhile, one student in the opposite corner of the room reflected, "Can you believe all this coding for this movement?"

---

[26]iCODE provides new ways to program a growing number of popular educational software. It also provides project tutorials and space to showcase the completed projects (iCODE, 2012).

Ms. Wood expressed to me that she is always on the lookout for good resources for her students. Moreover, students can look for problem-solving strategies on their own without her assistance. There are always a number of students who would go home and study the coding on their own. However, most students would ask the teacher for assistance or for a resource she could provide. Ms. Wood sometimes would ask students to study specific games for innovation. It usually depended on what students needed for their project. Some students might get rid of their first game and start over to use a simpler solution. While learning at this grade level, students usually come to understand that their original plan is often more complicated than they had thought. This forces them to both stretch their skills and start learning to seek a better or easier solution, if necessary.

One student was even testing sounds for her games. Ms. Wood walked over to her and asked, “In what area do you want to play the sound?” She and this student continued to discuss the possibility of sound for this game. Sometimes, students had too much fun with sound. “Stop!” one girl said to a friend who sat next to her, because he was having fun with the Scratch cat sound. Ms. Wood went over to stop this student’s action. The cat sound stored in Scratch is always fun, but sometimes students have gotten out of control with it. As a researcher-educator, I am always glad to see students explore every possibility in the learning process, even if the outcome is sometimes unexpected and possibly a bit too much.

It was soon almost the end of the trimester, and students needed to complete their game in 4 more days. They tried to get Ms. Wood’s attention for help, asking such questions as, “Can you help me with movement please?” Ms. Wood kept busy checking with students and providing the necessary guidance. She could be heard saying, “How about looking at these games. They are similar to what you want to do for your game.” “Actually we can do something like this.” or “Good job! JR.”

Students also helped each other, providing feedback, comments, or assistance, such as, “What do you think about changing speed?” and “Oh, my, your hair is so funny!” I also spotted a student who created a conversation between two sprites in his game and asked his friends for more thoughts for a funny conversation. Teamwork always intensifies the quality of the work.

One student took a game from the website and discussed the game and coding with a friend seated next to him. Ms. Wood noticed this and went over to discuss with them the possibility of variations. The first day I entered the classroom, Ms. Wood remarked how good this group of students was; and after having been in this class, I can understand why she was so proud of them: They were active, motivated, and animated with conversation.

On the last day of class, students got a chance to play other students’ games, which is probably the activity in this class that students liked best and with which they had the most fun. In this way, they had a chance to learn what their peers were doing for their games. By that time, I saw some students were ready to submit their game, and they asked each other, “Do you want to play my game?” According to Ms. Wood, students are pretty excited and proud of their games in the end, and they enjoy showing them to their friends and families. This is obviously one of the greatest forms of encouragement for learning.

Classroom Environment

Ms. Wood's classroom is a computer lab with 24 computers. All of the computers are 14-inch Apples, set up against three walls in a U shape. There are 8 computers along the sides of two walls and 6 computers against the left wall. The other 2 computers are set up on an individual table by the center toward the left side of the classroom. Ms. Wood commented that she is able to easily view the students' work on the computer. There is a printer on the left side of the classroom connected to all the computers in the room. The big table she uses to keep students' attention during speeches and presentations is combined with six big folding tables, and it is in the center of the classroom but closer to the right side. There is a SMART Board in the front of the classroom for Ms. Wood to use. There is one whiteboard in front of the classroom next to the SMART Board. The whiteboard on the back left side of the classroom is where Ms. Wood keeps the course agenda. There are two doors on both front sides of the classroom, and her table is by the left side door. She also monitors each student's behavior from the location of her table. Ms. Wood has many posters displayed on the walls, most of which are art and design techniques, from color, patterns, contrast, and rhythm to typography, showing her love and commitment to her profession in art and design teaching. Ms. Wood has also posted the national and state standards on the wall above the printer, which shows the significance of their use for designing the curriculum in her class.

The Teacher's Approach

While discussing her teaching philosophy, Ms. Wood stated,

> My biggest aim is to teach students to be lifelong learners. My entire philosophy is on creating students to have more passion about learning, or get excited about something and want to learn more about it. I think the technology just fits where

> they act. I do not know what the lifestyle will be in the next 10 years. But, these students grow up with these technologies and they are part of their life. They utilize these digital media and technology well.

It is obvious to Ms. Wood that students grow up in the digital era, and all these technologies surround them and are fully integrated into their lives. They are engrossed in and encouraged to use these technologies. The students might make use of these technologies more and more in the next decade. And, students need to learn how to search and retrieve certain information as part of this use of technology. Ms. Wood hopes she can help students gain every advantage to feel digital media and technology within every aspect of their lives, thereby broadly and widely enhancing their learning. Further, she believes students should feel comfortable to draw from their digital life and utilize it, finding solutions without her assistance.

Furthermore, Ms. Wood's philosophy connects the concept of learning with being a good digital citizen. She emphasized the importance of becoming a digital citizen. The first step in helping students learn to be good digital citizens is for them to be responsible for what they say on the web. She gave the example: "Many students thought they can write anything and it does not matter. But it does matter." Accordingly, she teaches students the necessity of making helpful and not hurtful comments, whether commenting in a chat room or speaking online about other students' work. There were many times during my observations in class when I heard Ms. Wood remind students to think ahead in order to make wise, respectful, and friendly suggestions to improve each other's work. She even discussed why making the choice for a user name is also critical. Users need to consider the impact of responsibility and safety, and be careful not to let other people take advantage of them in the web environment. Students also need to be aware of the privacy settings on each website they enter.

Ms. Wood also talked about the work in her giftedness class. There students learn by playing the international learning game, Quest Atlantis[27]. While Ms. Wood's students were playing the game, a student was playing a game in which the characters represented students; and thinking it was cool, this student always manipulated the other characters in the game so that they hugged each other. Ms. Wood tried to explain to him that people normally do not give hugs to other people they randomly see on the street. Ms. Wood stated that it is also part of digital citizenship learning: Being aware that not everyone sees the world in the same way you do. She went on to explain that because many students play video games online, they usually think other players are the same as they are. However, students need to understand the virtual world is not the same as their neighborhood or circle of friends.

In her technology class, Ms. Wood usually gives a brief course description to the students and parents at the beginning of the school year. She talks about the possible projects students might do in her classes and the problem-solving process, in addition to a focus on national and state standards. In addition, she points out that she uses her web page on the school website for sharing lesson plans, useful website resources links, and a brief introduction about herself, discussing a background range of topics, from her art production, technology, and the yearbook to gifted classes. She also talks about how she plans the curriculum based on students' interest and potential needs derived from the

---

[27]Quest Atlantis is an international learning game in a 3D multi-user environment (Quest Atlantis, 2012).

national and state standards. The standards for the technology class are wide open, and the main point is to enhance students' critical thinking, problem solving, and creativity, besides learning to be a digital citizen. Ms. Wood deliberately highlights these points while planning curriculum.

Further, Ms. Wood mentioned her understanding that the high school nearby teaches film, animation, graphic art, game design, and more, and explained that the game design project in her technology class is in a programming-based learning environment. She pointed out that this high school also provides a renewable energy and sustainability class. Accordingly, she conveyed that she wanted her students to have a basic perception of these subjects before entering high school. She indicated that she might change her curriculum based on the District's request and fit for society today. Regardless, she would continue to maintain the high standard of skills that might stimulate students to learn and further their thoughts for their high school learning and career path.

Ms. Wood has taught the Scratch program for 3 years and agrees it is a practical program for middle school students. She expanded on her views about Scratch: "Learning from making a video game not only stresses programming but also the ability to think from the varied perspectives of the players as well as game makers." Ms. Wood emphasized the boy students' perspective, because she feels that boys normally like to play video games more than girls. Although some boys in her class show high interest in gaming, she would get them to start thinking about the complex tasks behind the games themselves. Ms. Wood hopes students really learn to think differently under this training. Moreover, students have the opportunity to think differently more often, because they normally do not get the chance to do so in other classes.

In the Scratch project, Ms. Wood said she hopes students would get to know some computer programming and understand how computers react, depending on the command statements. The game-making experience, though interacting with the computer, is different compared with playing. Via game making, students learn how to think and plan their ideas and then put these ideas into the practices of programming and general interaction with the computing environment. She also makes certain her students understand that game planning represents not only what an individual wants but must include the further consideration of the audiences or players. She commented that usually students think about a game based on their own thoughts; however, they need to think about what kind of people—age group, gender, and more—would play this specific game.

Students learned while making a maze game and an individual game. Ms. Wood expressed how the maze game activity was a way to help students quickly be successful in game making. Students learned how to design a game for different audiences and how to make characters do what they wanted them to do. Students usually got comfortable with the Scratch program quickly and were soon willing to try to create a little harder game. Whereas she did let most of her students work on their own games at the start—though not many of them were successful—it was Ms. Moore's belief that a solid foundation in Scratch provided them with more confidence as they progressed to the next levels.

After the maze game, students worked on their individual game, and Ms. Wood gave them four possible choices for the concept or goal of the game. While talking about topic choices for the final project, Ms. Wood expressed that students would go wild if she let them to do whatever they wanted. She described this process: “Usually I gave them a broad topic and some examples, and students would explore the possibility for the topic based on their experience.” She explained, for example, that when using the topic of educating their audience, a number of students applied their own learning experiences while growing up, and some thought about their experiences in other classes.

For inspiration, Ms. Wood gave students some useful links to game websites related to the project. For example, games, such as the climate change or human rights game, do not place emphasis on winning or losing. In actuality, students get exposure to viewing different games besides competition-concept games and start thinking along these lines towards what they can do for their own games.

Ms. Wood commented that students learn to think from playing games. For example, the game about human rights teaches students knowledge in this specific area and the modifications of life based on choices made in the game environment. Once students have played the game, Ms. Wood can easily discuss issues regarding the problems, influences, and strengths associated with the concept of human rights. Students can then think further about the implementation of these ideas for their own game. Also, students usually do not have the chance to play games in other classes, and they enjoy this non-traditional learning technique.

The form of learning in Ms. Wood’s class is project based, which students usually do not experience in other classes. Students do three projects in a trimester, and each project underlines the importance of process and planning. In Ms. Wood’s class, planning is a key to successful work, whether in a movie, 3D architecture, or game-making project. Students must do the storyboard or sketch for each project. Some students easily give up when facing a complex problem, but planning by sketching is a way for them to develop an overview of the project, which then forces them to think ahead about the problems they might encounter. Meanwhile, students learn to plan their work to complete the projects on time. In Ms. Wood's art class, the projects are usually shorter and include more planning and sketch. In the gifted class, students set their own goals and plans for individual projects. Students all learn about planning just by using a different focus.

Ms. Wood also underlined the design process for learning in her class. Basically, students need to understand the problem, look at it, research it, come up with possible solutions, choose the best solution, implement the solution to the problem, and evaluate the result. Further, if the problem is still not solved, students need to learn to persevere to the best result and be able to speak about the processes they employed.

Sometimes, students engaged in a process of reflection and spoke about what they did, why they did it, and how they addressed the issue. Because the time was limited in the trimester, Ms. Wood learned from everyday interaction with her students and adjusted her teaching to suit their pace. Students played other students' games by the end of the trimester to learn more about a different set of possibilities for solving the problems she had addressed in this project. The entire process, though set within a curriculum outline, was highly reactive to the pace and skill set of the class itself.

Additionally, Ms. Wood usually invites professionals to speak with the students, whether in the game-making or 3D sustainability architecture project. I was in the class when the game designer came to talk with students. Students showed enormous surprise to learn about some of the details of the game industry in day-to-day practice. For the 3D sustainability architecture project, there were two architects who came to talk with students. Last year, Ms. Wood learned one of her students' fathers worked for an animation studio. Also, she plans to invite some animators to talk with students. She tries to keep these connections with the community, establishing a relationship for future learning opportunity.

Discussing technology, Ms. Wood believes it is a tool to accelerate students' learning. Students get excited while using technology, and it actually helps them connect with the learning process. Especially working with Scratch to make games, students combine their knowledge in math, art, design, language arts, and the information chosen as content for making a game. Students learn to think differently when viewing the things around them, from the neighborhood in which they live to the whole world. Ms. Wood stated that as a teacher, she believes technology really magnifies students' learning.

Even if the school is technology driven and provides the necessary equipment and support, Ms. Wood believes it is also her passion in technology that adds to the effort. Reflecting this passion, she remarked, "Personally, I think students are motivated while using computers, and it made me excited to teach with technology." Ms. Wood usually learns the software on her own time, explaining,

> When I see any potential programs for teaching and learning, I introduce them to the students and set a project for them. In spite of that, I let students know it is new for me too and we learn it together.

On the topic of her approach to teaching, she talked about lifelong learning:

> My personal belief definitely affects my teaching….I am glad that I get to be a lifelong learner, and to myself, that is probably the most interesting thing, and I get to learn all these new technologies. And I really enjoy seeing students learn and get excited about whatever they see, do, or try something new. I teach the tools and guide them to solve the problem if I cannot be around. That is the most I enjoy about my teaching work.

Ms. Wood expressed how much her ardor is to connect students' learning, forcing her to constantly learn if only to keep pace. She is a lifelong learner along with her students. Nevertheless, she also commented that the challenge would be so much greater if students did not get excited about these activities for learning and were not motivated for education.

Evaluation

The evaluation for the assigned Scratch game-making project is organized into five categories: creativity and design, presentation, story, game play, and class time. Accordingly, Ms. Wood would rate each category from 1 to 5, corresponding to choices ranging from *not yet* to *exceeds*. The detailed emphasis for each of these categories is listed below:

- Creativity and design
  - Design: Does design show evidence of planning and creativity?
  - Characters: Are sprites and objects well designed and do they fit the game?
  - Background: Are color and images appropriate to color theme?
- Presentation
  - Visual style: Does the presentation style fit the target audience as defined by genre?
  - Technical quality: Does the presentation lack technical quality that detracts from immersion and engagement?
- Story
  - Engagement: Is the story properly engaging for the player in a way that makes him/her want to continue to play?
  - Thought provoking: Does the story provoke questions and thoughts that encourage an exploration?
  - Player's self-investment: Is the player properly invested in the character being played?
  - Education: Does the game educate the player about a specific topic or idea?
- Game play
  - Organization: Is the game organized in a consistent way for the user?
  - Skill building: Does the game play encourage skill building for the player?

    - Technical quality: Does the game play lack technical quality that detracts from immersion and engagement?
    - Fulfillment: Does the designer properly fulfill the pursuit of the purpose?
    - Worth: Does the designer have a goal in mind (whether in game play or story) that is worthy of pursuit?
- Class time
    - Time on task: Was class time used appropriately?
    - Class discussion/digital citizenship: Did the student support class discussion and provide on-line comments?
    - Group work: Did the student supported and help others with code?
    - Problem solving: Did the student attempt to solve problems through a variety of resources?
    - Learning: Did the student meet objectives of instructional tasks? (Ms. Wood's *Game Design Rubric,* 2012)

Engagement

Every trimester, Ms. Wood tries to engage with students by establishing a relationship with them and planning projects related to interests in their age group. She stated that technology is an essential component of learning. According to Ms. Wood, technology is a great tool for use with students and provides something they just cannot do with pen and paper. With technology, access to information is faster and right at your fingertips. In her words,

> That is why I like to teach technology. And I can teach these students how to use the proper tools to open the door, accessing knowledge outside of classroom. It is an extremely powerful tool and will excite the students if you use it in a right way.

Ms. Wood said that some students wanted to work in the lab just because they like to use computers. In this trimester, there were two girl students who always came to the lab to do their homework. These two students explained that they liked to use the computer and also could do their homework together.

Ms. Wood remarked that when students get their homework done at home without her instruction that shows they are motivated and engaged. If a student brings his/her project home to show his/her parents, this student is genuinely engaged with what he/she is learning. Similarly if a student is always in a hurry to turn on his/her computer when he/she comes to class, this implies engagement. Engagement was again evident when two students in Ms. Wood's early morning class always rushed to get to class and turn on the computer to start working on whatever mission was at hand.

Creativity

Near the end of the interview—the conversation between Ms. Wood and me—Ms. Wood commented, "For the whole class, I hope students learn to be creative. We work toward the creative solution." Moreover, she hopes students would take knowledge from other classes and bring it to her class for whatever outcome they want to achieve with technology. This represents another facet of learning to be a lifelong learner—a pivotal lesson in the 21st century.

In Ms. Wood's opinion, the ability to transfer knowledge from other classes or make connection on the subject matter or combine these elements into a new or different idea is creativity. The students in her class were normally only 12 years old, but many of them expanded their efforts beyond their years to reach a quality product. For example, a student created a story of a fish eating trash to point up the green concept in our environment. It is exactly what Ms. Wood discussed in using knowledge from other subjects in a new or different product.

Students' Response

Tommy. Tommy used the first computer by the front door and always discussed the work process with his friend who sat next to him. Once in a while, Tommy would come to ask Ms. Wood for some advice or assistance. He also showed energetic teamwork and did not want to waste any time or lose any possibility for success in his learning and working together with friends in the class. From his polite conversation to Ms. Wood and his work attitude I observed in the class, Tommy had a strong understanding about what he was doing and what he wanted to do. This is evident in his comments from the interview. Here, in his own words, is Tommy's statement:

> In this class
> We do everything on the computer
> Fun
> Made movies
> A 3D eco-friendly house
> Also
> The current task
> Video game making
> Just fun
>
> A required technology class, last year
> Did a movie maker
> Mine was a historical project
> And, 3D modeling
> Also, a file on media safety
> There is always an educational purpose, behind
> Really like it
> I want to continue to learn
>
> I did know I would make a game before I sign-on this class
> I play video games
> So I hope to learn to make one
>
> There is this game on my iPad, I like
> So I want to do a game similar
> Teacher mentioned, educational
> Thought about the periodic table in science, we just learned
> So I thought I can bring it in
> My idea
> Only took few minutes to think, the game I want to do
> I just need to think an educational way, go into it
>
> My game is more about educational
> Teach periodic element table
> Airplane flies to click the elements

But it is also no clear win
Continue flying around and click elements

Challenge
Very hard to learn coding
Even a simple game like this
Many different things put on it
But
I do enjoy it

3D modeling house, quite hard
Because a lot of eco-friendly stuff
I do not like it
But
Other than that
Is pretty fun

Level of engagement
If from 1 to 10
Mine is about 9
Coding hard
But it is a lot of fun
I like to come to the tech class every day
I like the Scratch project the most
The only time I lost interest is,
With the 3D modeling thing

I like to draw the little characters
Design the background
Figure out the coding
Be able to play the game I made
A lot of fun

Think outside the box
Hard to put educational thing into a fun game
So I have to think
Keep thinking
What element do I need
Useful

I do ask the teacher or friends
If I have the questions
My friend who sat next to me
We talked a lot
Help each other

Like I know how to do scoring
And he knows shooting
So we help each other, a lot

If it is too hard
I might change around
But
If I really like this idea
Ask the teacher for help
Or
Someone who knows the coding, help

I do not like the random Google searching
The teacher usually knows quite well
I ask her

Four weeks is about right
Do not need too much time, in this stuff

I don't think the time really affects the learning
Some people might think a longer time would help
Producing better work
But, not really
We have good amount of time, work on it

We learned a lot in this class
How to build the eco-friendly house, movie,
And how to make a video game with coding
All about technology
That is what I want to do

I've learned a lot from this class
Cannot think anything else, I want to learn
This moment
I think my friends learn the same things, like me

I am proud, the hard work I put in
These things take time
Cannot do it quick
I do my best
I am proud of myself

Very meaningful
Like I said, I work hard a lot
If I did not make it, I waste the time I put on it

It is meaningful
Because I put in a lot of time
And it is good

I am happy I am good at computer
I am pretty good at technology
I am pretty handy, as I know
At home
If my sister lost files, on the computer
I can find it
I download virus protection
For our computer
If my family ask any questions
I go on-line to search
I can do stuff like this

I used that kind of helping learning computer games
When I was about 3
We had a family computer, shared
I had my own computer, about 10
It was very slow
Not keep it anymore

I like video games
A game, an old game, Skyroom
My favorite
I play games
About one or two hours a day
I want to be a pilot when I grow up

I use iPod for video games
Listen to music and watch video
Funny video
On YouTube
I go on Facebook
Once a while

On my cell phone
I text and call my friends
I normally do stuff with my friends

Easier to do more stuff on the computer
But, more complicated
Pen and paper
Good for sketch

Good for design
But I would use the computer
For a better final draft

For my homework
Sometime, I type on the computer
Most of time, I write on paper
I like to do math on paper

Creativity
Something you come out on your own
And that is a great idea

According to Tommy, he learned quite a bit in his technology class last year, because it is required for 7th grade in his school, and he had the interest to continue learning it this year. He agreed that he has a talent in the technology field especially. Tommy stated he had difficulty with coding, but it did not diminish his fervent interest in technology.

Judy. Judy's game is about building a healthy pizza. However the player cannot choose just any ingredients for the individual pizza but must follow the instructions. Judy remarked that her game reflects that many people easily ignore following easy instructions in life today. Reflecting her interview, she provided a snapshot of her experiences with game making and technology. Here, in her own words, is Judy's statement:

This class is about
How to use software
How to design the project
How to be a good designer

I didn't know I would learn to make games in this class
I just wanted to learn about technology
I want to use computer and learn different things

I don't think I am very good with computer

I just like to use computer
I learned computer, 6^{th} grade
Microsoft stuff
7^{th} grade, last year
The technology class
Learned the basic, interesting
This year
We get into it
Now I can do more than the basic

My game
About making pizza
Choose any topping, sauce, cheese, for a pizza
This game is about
Following the instructions you receive, for a pizza

For thinking about the idea
I thought about something in design
I am not very good in design
So I thought it would be a good one
I like to be able to deal with different types of design for this project

I didn’t talk to anyone, for idea for my game
Took a couple days
Then
I can’t think about anything else
Beside it

The teacher has prepared a storyboard sheet
So I have to plan ahead
Plan ahead, help

Drawing and planning, my favorite things
I draw on the paper
Then scan it in

The programming is pretty hard
Challenge
If you do not get it right
Computer does not do what you want
Will end working not correctly
I try to learn as much as I can

The teacher usually taught tips we might use
The basics

Let us play with it
What we can and what we cannot do

I talk with the teacher, when I need
For example,
Programming problems
She helps me
With it

The hard part is, during the week
Need to stop, go to a different class
While getting an idea
Forget about it easily
When stop for a different class
Hard

I do not work outside the class
Only in the class
The next day
Came to continue working on it

Sometime
I do hope I have more time on designing
On the actual game
Would help me to view it much easier

In this class
I learned
Work with different software
Different stuff I can do with it
Many options I can do with it

Meaningful
Helps me to understand, many things
Like learning all this software
Work on the project
Based on the use of this software
I like my dream house the best

Friends in the class, help each other
Any problem
I can ask, for help

I am happy with my projects
I am happy with this class

Because I am learning something new
I like to learn new things

I have not seen any friends of mine
Who does not like computer

I don’t have Facebook
I have a cell phone
I text
Play games
Go on Internet
A lot of fun

Sometimes
I just like to watch
Music video
Listen to songs
On YouTube
On my iPod or phone
A lot

Never lose interest
Fun
It’s entertaining
I enjoy it

With friends
Text each other
Just like talking with people
But it’s on text

I do not have Skype
But a friend has it
So
We Skype people when we hang out

I search for the schoolwork
If there is a topic
I go on-line

If my friends have questions
I would say
Give me the phone
I search it for you

With pen and paper
More manipulated to do design
On the computer
Not as limited
I can do whatever I want
I enjoy working homework on the computer

Creativity
You know what to do, what you want
Like figure it out in the point of your view

Judy revealed that her desire to take this class was simply because she liked to use the computer. Her favorite use was hanging out with friends via chatting on the Skype, watching videos on YouTube, or searching for random information. She acknowledged that her friends and the teacher's assistance provided useful inspiration in this class.

Sally. Sally's straight, beautiful light-brown-colored hair and her subtle personality definitely left her mark of identity on the class. She was always quiet while working on her work or talked softly with friends seated next to her, but her appearance, complimented by her hair, showed her grace. Sally was in Ms. Wood's gifted class last year. According to Ms. Wood, Sally's work always showed depth of thinking behind her work. Here, in her own words, is Sally's statement:

In this class
I designed my game
Designed the house
And designed animation

I like the house one the best
Because I used Sketch-up before
Familiar with it

Nervous about making games
Maybe because the coding
I knew Scratch before
I was in the GT class
I learned some from the teacher

But still don't feel comfortable with it

I took the technology class, last year
Required
We did Sketch up and GarageBand
Making music was fun
I like it

I like to use computers
But
Sometime can be frustrating
If I can get things, I want

This year
Definitely
Get more comfortable
With the computer and different programs
I like to learn more, about computer
Figure out new stuff

I use the computer, at home, too
Sometimes
Go on YouTube
I like to watch the music video

Facebook
I go on twice a week

On my cell phone
I text, a lot
Sometime
I check Facebook
On my cell phone

I use Google
For searching an idea
I type the questions
Get more info

I use computer for typing my homework
I use the computer, mostly everyday
I hope
I can use computers for doing more schoolwork

We use computer in language art

Sometimes
In history

We did not really have tech class
In the elementary school
It would be easier
If something I knew
For example
I learned more about Word last year
However
Seems like they are something very basic
And people should know

If I knew the typing before
It would be better too

I do lose interest for working
Sometimes
Like
For the animation one
Got boring
I did *Twinkle Twinkle Little Stars*
The same animation
Over and over again

For the game
Last year we did something, the same
I use the same idea
For the one this year
But
In the ocean this time
The fish needed to collect a lot of trash
If you do not do it
You would die
Learn the ocean pollution is bad

The idea for my project
Always random
Like for the house
My uncle just bought a house
I did based on his

The house is not boring
Because I can design my own house
The game was

A little bit boring, for me

I think
Hard to teach technology class
Students need a lot of help
All the time
Teacher walks around, help

The first day
Usually mess around
See what we can do on the computer
Then
Getting ideas together
For a project
The rest of days
Figure out how to work
Everything

I like to mess around with the computer
To see what I can do

In the game project
Learned about coding stuff
Make the characters move
Change colors of the characters
Like this

Talk about my work with friends, next to me
We share the work, with each other
If I had hard time to do
What I want to do, on the computer
I ask my friends
If they do not know
Ask the teacher

I think the length for working on one project
Is about right

Learn to make games
Think about a video game
Time they put into it
Not easy
But
It is not meaningful to me
I play games, sometimes

Okay if I know how to make games

But
I am happy
I learn more what I can do on the computer
A lot faster

This class
Helped me to think
Differently
For example
In Sketch up
I can visualize the whole building, whole
My house on Sketch-up looks a lot of different
Compared with it on the paper
I like the one on the computer better

The challenge is
Try to think
Learn how to do
All this stuff

I don’t use any sketch book
I keep my thought in my brain

I like using computer
But that is not something
I would say,
“Oh computer.”

Yes
I did see some friends of mine
Who do not like to use computer
Maybe because
They do not like to make games

But
My friends all like YouTube
A lot
Most music
Sometimes
Some funny videos

Creativity
Think about ideas easily

Put them together
On something else
Usually
Idea comes to mind very quickly
Without doing a lot of thinking

Sally clearly liked to use the computer rather than making a game-based project. Probably, at some point, the process of coding scared her. The 3D architecture project she did previously was more interesting to her. However, she was happy that she had opportunities to explore a variety of software in learning and felt more comfortable with them after this exposure. It was clear that after this class, Sally found value in the use of digital technology besides its being purely for entertainment.

Sam. Sam sat next to Tommy in the class, and two of them discussed their projects together all the time. Compared with Tommy, Sam showed the more quiet and calm disposition of a gentleman. During our conversation, he remarked that he was a very detail-oriented person, and I could detect this easily by the way he addressed his responses to my questions. He mentioned several times how schoolwork is important in his family, and this encouraged him to work towards developing a scholarly attitude in his work and goals. Sam worked very hard to make sure his work was perfect to him. Here, in his own words, is Sam's statement:

My project is a game about airplanes
There is a target thing
Players shoot it

The idea
I think I always wanted to be pilot
So, kind of my interest
I like flying

Took a couple days
Get the idea

For the game I want to do
Through few classes
Gave me more thoughts about it
Make sure
That is the one I want to do

Due day in 2 days
I feel I need more time
Because
Like I said
I am a very detailed person
Want perfect on everything
Maybe the extra week, help
Be sure everything, very good
Works out well

I think my friend and I
Learned a lot about computer
How to think problem solving
How to design digital stuff
How to use it better and be proficient
Being able to use programming
We do it better now

Challenge
For the game
Is programming
Very confusing
Hard to do it
Sometimes
I would stop for a minute
Look at the options I have
Think what might help
Make it work

If not work
I'll ask for help, someone who has more experience with it
I talked with the teacher
Used iCode sometimes
Fixing problems
Learn more technique stuff, challenge

Never lost any interest
Very cool
It is the place to be creative

I really enjoy doing it
Let my mind free
Be creative thinker
Creativity
Is let your mind flow
Be able to construct something
Put things in your mind

I like drawing
Be able to make it as realistic as possible
Make it looks real
I tried to focus on details
Drawing on computer is easier than on paper with pencil

On the computer
I can choose what color I want, easier
With pen and paper
I need to draw out and add color
With freehand
Easier on pen and paper
Want to be precise
Good on the computer

The teacher teaches well
Whenever I need the help
She is always there
I think
She is a great teacher
Good at what she does

I show my game to my dad
My brother
My whole family
Last weekend
It was fun to show them
They were amazed
I can make something like that

I like the game project more
Because I can be more creative with it
Be what I want to be
I am proud I can do it
I like the way it looks
It lays out
My creativity

When I did the movie project
At home
My brother saw it
He likes it
I think he plans to take this class too
He is in 4th grade, now

There is a computer at home
Shared with my family
I check Facebook, sometimes
Not very often
Maybe, once a weekend
Good way to communicate with friends
I don't use it all the time
But it is very useful

The computer
I use it every day
For school homework
Web
The source for information
Do research
Research for what I need
Only play a little game
In my family
School is very important

For schoolwork
I do research
Like for history and science
Because
A lot of good resource, on web
Wikipedia
Also use it for math
There is a website the teacher gave me
I use it sometimes
Help to explain
What we are doing
If I forgot or am confused with something
I can go on it
Very grateful about it

I think
The computer, Internet

A great source for information sharing
A way to communicate
A tool to do drawing, typing
I can keep certain files
Organize things
My friends all agree
All enjoy the computer as I do
I would like to use iPad for my school, great tool

This class
Is meaningful to me
I really enjoy it
I am taking the technology in the next trimester class
I am willing to learn more

I hope to learn more about computer and how they work stuff
Because in our age
The computer is everywhere
I thought
Would be good to learn more

I use cell phone
Talk with my friends
It's more like communication than a toy
Some students bring it to the school, use it
But
I leave mine at home
It is more distraction in the school
It should be like a tool than a toy

A lot of students
Feel comfortable with technology
Because so many people use it
There is some dangerous
But it's still a very useful tool

In this point
I am disappointed
The class is ending soon
Time passes by too fast
It is so soon

I really enjoy this class

I know I can do more

I am able to use and be proficient from what I have known
Also
I look at the games differently
Appreciate how these guys' hard work, for one game

I say
My technology skill is pretty good
And, I want to learn more

According to Sam's statement, he agreed that students need to learn more about technologies, because we live in the digital age and they are tools instead of toys. Learning more about digital technology in this class helped him think, for example, about planning the projects he was working on in other classes. Additionally, he understood the challenge from the professional engineers or game makers' standpoint. Sam also enjoyed sharing his schoolwork through conversation with his friends and family. He expressed the important role of his family in his study and how they support him to engage with the highest quality of education.

Behind the Scenes

As mentioned above, Vista Heights Middle School emphasizes technology. Ms. Wood shared with me some principles behind this emphasis. The school is about 18 years old. When the school opened, it was designed with the idea that it would emphasize technology, and the principal and teachers worked toward this goal. However, the budget has not been able to keep up with the need. Ms. Wood expressed this reality and their hard work in this context. The school has a new principal now, and he also is trying to do as much as he can in this direction. The new principal might introduce the iPad for classroom teaching and learning to expose this concept to the school. Nevertheless, there are contrasting opinions from one group to another. The district wants to maintain only the use of personal computers in the school environment, whereas the principal of the school has the view of not limiting the tools used.

Ms. Wood commented she has observed that younger teachers prefer to use technology for teaching, because they have more experience with it and are willing to try new tools. Currently, there are six laptop carts with 16 laptops for each cart in the school, and they are always checked out every day. The students probably get computer experience once a day in their regular classrooms. In the math department, there are seven carts, with 16 netbooks in each cart. Also, in each hallway, there are mini labs with six to eight computers. Actually, there are many computers in the school as a whole. Ms. Wood pointed out that “language arts teachers use computers for teaching a lot. We really try to get more computer experiences for each classroom.”

The facilities are based on the needs of each individual department. For example, the math department got a SMART Board, projectors, and a digital camera a few years ago. Along with that, the science department updated its equipment this year. Per Ms. Wood’s understanding, the math teacher uses the SMART Board and Smart-clip all the time. Smart-clip is a cell-phone-sized device, which the teacher can use to quickly see, for example, how students answer questions a, b, c, or d on the Smart-clip. Depending on their responses, the teacher can teach the correct information associated with those particular questions to an individual or group.

One math teacher also teaches animation or activities related to the subject of teaching and learning. This teacher discussed the possibility of students’ recording video on the smartphone for one activity, while Ms. Wood shared with him what technology equipment she uses in her class. Ms. Wood reflected she might think about other ways to use technology for teaching and learning if she does not teach at a computer lab as her classroom. The policy of smartphone use is open in the school as long as students do not talk or text during the lecture. Many teachers let their students use the smartphone as a calculator, and Ms. Wood lets her students make notes or put homework on it as a reminder. She also uses technology for her gifted and art classes and commented she would not know how to teach today without using technology.

According to Ms. Wood, there are usually five students who come to use the computers regularly after school. She elaborated, "I think that two of them just really love technology; they do it at home, and they also use their time here to do it." There was one student who liked to do his computer work in Ms. Wood's classroom, so he could talk with and ask Ms. Wood and another tech teacher for help, whether with Sketch-up or Scratch. Ms. Wood thinks this student really wants to learn more about both programs. In addition, she mentioned two girl students who came in so they could hang out with each other, while working on their homework or searching the web. Occasionally, some students came to finish their projects, and some came in to do other class projects.

Ms. Wood also shared with me a student's Flash animation, with his own version of "The Tortoise and the Hare." Although he was in her class, this student went to the high school for an advanced math program once every other week. He had free time the week when he did not need to go to the high school, so he chose to stay in the library, working on this animation in his free time. Obviously, he is very a motivated and creative student.

CHAPTER FIVE:

THEMATICS, EVALUATIONS, AND IMPLICATIONS

Overview of the Study

There are many concerns in contemporary education: financial, cultural, political and many more profound and nuanced issues. Using digital media technology for effective learning and to better facilitate teaching is important on many levels, including the very ubiquity of these technologies. In actuality, today's technologies relate to education in many ways, and educators have long practiced the pedagogy beyond a form of one-way communication. The tools we use today have made the process of teaching and learning fully interactive as a dialogue between teachers, students, tools, concepts, instructions, and attitude. Education takes places within a social-cultural context. In modern society, individuals employ digital media and technology in naturally occurring ways. The purpose of education in this form is contemplated in the context of social change, which in turn, is fully integrated with digital media technology. The daily use of all forms of digital media has become part of our lives and therefore becomes one of the key *components* of education. Because education is considered central to contemporary life, today's digital-age, truly effective education must consider these elements of society—the changes they bring about in our social and cultural environment—and apply these contexts to today's curriculum. In modern society, people use digital media daily and seamlessly, so we, as educators, need to consider integrating digital media education into education today and in the future.

As discussed in Chapters 1 and 2, the awareness of integrating digital media and technology into today's curriculum has become a focus of many educators' attention, and schools are interested in how to integrate its use to foster success in students' learning. Whereas these approaches are diverse in the areas of purpose, methods, and relationships, and successful outcomes are of primary concern, we, as educators, need to understand what has been practiced in the schools thus far and how we can use that data to improve students' experience as we move forward towards new and more cohesive techniques of learning in the digital era. This study focuses on how the use of digital media and technologies, and the teachers and students' approaches are applied in the making of video games for learning in select middle schools in suburban Denver, Colorado. Modern educators and educational experts might use the findings from this examination to consider the value and employment of digital media and technology in a K thru 12 school system.

Historically, many educators have reviewed digital media and technology in education, thinking of it in a range of roles, including tutor, information supplier, communications facilitator, motivator, competitor, or stimulator of a specific activity or thought. There is no doubt, digital media and technology can serve all these and more. Many aspects will condition how well it serves the users in any particular case. We, as educators, are yet unable to see all the potential of these tools, and the imaginations of our learners will be our guide, because this imagination is proof of their connection to learning via these methods. Today, teachers are using these tools, often on their own initiative, and this commitment and preparation bears proof of their belief in the value of this component in education. Where teachers are open to these technologies and their techniques for learning, students are encouraged to explore the application of digital media and technology within today's and the coming digital ages.

The modern society we live in now is viewed as a digital society. Most people and many students enjoy using digital technology as much as possible and have many of its elements integral to their daily lives. Constantly reforming education to maintain currency is critical for the very success of education. The tools used are more than a focal point for the analysis and evolution of the frameworks of pedagogy, because they assist in understanding the best techniques to aid students as they take up the challenge of learning. For educators to attain the levels of advancement in interest, capability, and stimulation of their students' interest and engagement, and place knowledge within the grasp of their attention, careful consideration must be given to the processes of digital media. The emphasis is on not only the ability to adapt their use but also what kinds of content, skills, and attitude enhance students learning within society. This means the significance is *how* to teach and learn, in many ways as important as *what* to teach and learn.

Taking into consideration the change from the "lecture and learn" model of the past to the fully interactive modality of learning available through digital technologies, students gain greater responsibility for their own education and view their education as a process of lifelong learning. In today's environment, students are accustomed to fully interactive tools at their disposal, for example, email, mobile phones, on-line interaction, and more. The fully interactive modes available today from digital technologies facilitate their real-time and ongoing interaction with the subject and, in turn, take ownership of the work at hand through their use and experimentation. Students learn the consequences of thinking ability and problem-solving skills that are connected to a wide variety of utilizations of the tools around them.

Many studies have indicated that one way educators can improve students' learning experience is by increasing engagement levels. The level of engagement in the learning environment can be increased, and it is this engagement that holds great potential for encouraging positive outcomes. When students believe they are not thriving with their schoolwork, they often disengage (Finn, 1989). Game-making based learning encourages the way the "digital natives" learn and engages them in meaningful ways (Gee, 2003; Prensky 2001; Shaffer, 20006; Van Eck, 2006). The best of digital media and technologies, like game-making based learning, offers the opportunity to embed learning in an authentic environment and embrace engagement outside of the traditional and historical formal educational setting. Students discover the activity of realizing their own vision by using the tools of programming, game making, and other technologies that produce results, confirming that digital media and technology can be used to create a motivating learning environment. If the engaging properties of computer-based games can be turned to an educational advantage, the leverage that is realized could be great. Furthermore, interest, motivation, and engagement are all closely related (Libbey, 2004). And in this relationship, these digital natives become deeply engrossed in the task at hand—often overlooking the task as work and taking up real learning more organically.

To succeed in understanding these issues, four research questions guided this study: (a) What are the teachers' intentions for teaching digital media? (b) What happens in the classes through the use of digital media? (c) How does the use of digital media affect students' educational experience? and (d) What are the implications for education in general? In order to explore these questions, qualitative research and the educational connoisseurship and criticism methodology, as designed by Elliot Eisner, was used for this study, as discussed in Chapter 3. Qualitative research fosters the insightful understanding of attitude, information, and communication in a natural setting. The aim of the educational connoisseurship and criticism methodology is to explicate an accurate and vivid portrait of the situation that is viewed. The researcher is responsible for understanding and interpreting the particular situation and then offering a detailed illustration of that situation. Connoisseurship is concerned with matters of quality and the means through which one comes to know the complexities, nuances, and subtleties of aspects of the work in which he/she has a special interest (Eisner, 2002, pp. 68-69). The focus of criticism might not only apply to the problem of the complex and subtle aspects of educational phenomena but also raise the awareness of the problem that is addressed (Eisner, 2002, p. 86). The intent of this method matches the intent of this study. My intent has been to learn what the digital age offers education, why digital media education would be a central thought, and what educators can then take from this analysis to make a positive impact on learning.

The educational criticism method has four components: description, interpretation, evaluation, and thematics (Eisner, 1998). The interpretation of descriptions and evaluations are used to contemplate the positive attitude in the field and help guide consideration for future research. In Chapter 4, I provided organized descriptions constructed with individual qualities from each teacher's practice in the theme of his/her classroom as they emerged and, in turn, their students' approach. In this chapter, I supply the connections to accompany the interpretation. Further, I offer an evaluation of those themes I encountered in response to my four research questions. The goal is to provide educators and educational experts an understanding of what is currently taking place and how we can use this information to improve students' learning experience and the value of facilitating their commitment towards lifelong learning in the 21st century.

During my research, I observed the practice of four technology teachers in their technology class as they focused on the task of making video games project. This study is conducted based on classroom observation and interviews with the teachers and chosen students. All four teachers teach in middle schools in two different districts in suburban Denver, Colorado. These four teachers have 5 to 10 years of experience teaching digital media and technology and have taught game-making projects using Scratch for 3 of these years. I selected the participating teachers based upon my understanding of their practice and the curriculum's connection with these districts. I observed the teaching and learning in these classrooms over a period of 4 to 7 weeks. Then I conducted interviews with the teachers and students. Interviews can be a very rich source of information and a powerful resource for learning how people perceive the situations in which they work (Eisner, 1991, p. 81). The participating students were selected based on the teachers' recommendations or students' choice, or both. The interview questions, like the observations, were based on five dimensions that affect classroom activities: the intention, curriculum, pedagogy, structure, and evaluation (Eisner, 2002; Uhrmacher, 1991). The interviews offered a connection between classroom practices and both the teachers and students' thoughts behind and resulting from these practices.

Discussion of Themes and Responses to Research Questions

I used the lens of Eisner's (2002) five dimensions of schooling—intention, school structure, curriculum, pedagogy, and evaluation—to uncover further understanding related to conducting the observations and interviews. The first theme that emerged is the teachers' opinions of the purpose of learning with digital media and technology, and their intentions with respect to teaching it and planning their curriculum. The second theme reflects the impression of what is actually happening with respect to the classroom teaching and learning. The third theme encompasses the idea that the impact of learning has been reflected with digital media and technology's assistance. The fourth theme that emerged is the goal of understanding the students' learning expectations in the digital era. According to this research, students are enthusiastic to learn with digital media and technology, and the educators in this study have focused on how best to integrate it into the learning experience. These themes are further discussed in the research question responses below.

What Are the Teachers' Intentions for Teaching Digital Media?

Ms. Moore said with a sigh at the end of the interview, "My role is to prepare the students for any possibility….Students would understand my teaching is not an isolated subject, and it can be used in many specific areas of their life." Because digital life changes so quickly, Ms. Moore hopes she can help students become acclimated to these changing environments and learn with and from this digitally emphasized modern life. Ms. Wood also commented, "I do not know what the lifestyle will be in the next 10 years, but these students grow up with technologies that are part of their life.” Mr. Winter reflected on how his beliefs, applied to his teaching, will assist students to broaden their viewpoints for the future. Mr. Snow expressed that his challenge is to keep his teaching up-to-date and knowledgeable, so that new students coming every year want and need to learn more about these technologies. In the opinions of these four teachers, they suspect digital media and technologies are significant conduits to knowledge and tools for students today and in the future. Even if they cannot be sure what are the predominant areas of knowledge students will need to master for the future, these teachers try to provide a useful and contemporary path for their students.

While expressing their goal for teaching the digital media and technology class, the four teachers presented four objectives:

- Teach students assorted technologies and inspire them to continue thinking and using these devices and techniques outside the class;
- Assist students to be capable to function in contemporary life, which is also to live in the digital era wisely and widely within every aspect of their lives;
- Enhance students’ critical thinking, problem solving, and creativity;
- Teach students to be digital citizens.

Ms. Wood stated that her students might employ the use of these technologies more and more over the next decade, and they need to draw from their digital life and utilize it, finding solutions without teachers’ assistance. Mr. Snow and Mr. Winter were of the same view as Ms. Wood, and all demonstrated that they are facilitators of their students’ learning. Mr. Winter explained, “We teach students the concept and inspire them with an idea, they run with it." Ms. Wood emphasized learning to be lifelong learners. Ms. Wood expressed how much her passion to connect students to learning forces her to constantly learn herself, and her joy is seeing students get excited and search for their own ideas and projects for learning. For example, Ms. Wood always looks for opportunities to share good resources with her students. In consequence, students can look for the tools to problem solve on their own, without an instructor's guidance.

In Chapter 2, I selected various scholars' words to define lifelong education as the ability to continue learning and the development of the human potential of individuals (Ch. 2, p. 62; Longworth & Davies, 1996; Rojvithee, 2005). Living in the digital era, with new information and inventions arriving every day, individuals learn to be competent with their use of the techniques of these concepts and tools. Many young learners are inspired to practice their creativity in the context of learning, and learning with these digital media technologies. Field (2006) emphasized that the outcome of lifelong learning includes skills, such as learning how to learn, application of new knowledge, critical reasoning, and information management and processing (Ch. 2, p. 64).

The four teachers I approached for this study have quite consciously acted in accordance with these concepts. Learning with digital media and technology assists students to engage with the process of learning and encourages them to participate with and share their learning with modern society. Ms. Wood indicated that students get excited while using technology, and it actually helps them connect with learning today as well as the process and goal of lifelong learning.

When I was admiring Ms. Moore's intent to also include laptops for her math class and her subsequent application for a grant to purchase them, she stated she always tries to reach every student, and technologies are a great tool to cultivate their interest to learn. She hopes students will have fun, want to become more involved, think how they use learning experiences, what other ways they can use them, and more. In Ms. Wood's school, which has a curriculum that is technology driven, she spoke about how an increasing number of new teachers find pleasure in using digital media and technology for their classroom teaching and learning. She cited the example of making computer games or videos in their math classes. The aim of the school is to extend students' ability to employ digital technology in learning as they use it in life. While Mr. Winter was talking about how one of his students made a game for a required science report, he conveyed his strong hope that students can use what they learn in his class and apply it to other learning experiences. Discussing further the topic of lifelong learning in Chapter 2, I indicated that today's students undertake critical engagement and active participation to gain a rich learning experience in both traditional academia as well as digital media and approaches to technology-facilitated learning (Ch. 2, pp. 63-64). Many educators have been aware of this topic but need to consider the new context of how learners' informal practices with digital media can support their more formal learning. Mr. Winter said,

> I hope we will see students use digital media and technology more and more effectively, and I hope that teachers will view the technology differently and agree that a different form of presentation is valuable in and of itself.

Mr. Winter believes technology can overcome many limitations seen in traditional methods of teaching and, over time, enhance students' learning experiences. Ms. Moore has even thought about the possibility of a student's having a partner outside of his/her class and learning together via the Internet.

When I asked about the choice of Scratch and making video games for learning as one of the components in their technology, Mr. Winter spoke about how the interesting combination of interaction and conception motivated him to teach a game-making program. The major goal is to start training students of this age to think of many different and divergent possibilities for solving problems. When Ms. Moore heard about the program, Scratch, she knew it would be a useful program to intensify students' diverse thinking in a learned subject and their view of the use of computers, with the guidance of understanding teachers. An example Mr. Winter raised was that a student could develop a game of organized notes to assist his/her learning task. Ms. Wood revealed she hopes students would get to know some computer programming and understand how computers react depending on the command statement, and heighten their ability to think from varied perspectives. Mr. Snow said that computer programming helps students think of having a conversation with the computer while using logical thinking, paying attention to details, and expressing their creativity in practice. Similar to Mr. Snow's belief, Ms. Moore referred to learning computer programming as logical processing. Also, she underlined that the programming lesson served the goal of attention to detail. Once students had a topic and plan, they needed to keep focused on this subject to accomplish their goals.

All four teachers learned about Scratch serendipitously from the suggestion of a co-worker, conference, or workshop. Nonetheless, they have developed deliberate and practical techniques to teach students about its use. Mr. Winter commented that because he is a middle school teacher, the priority for him is to cultivate students' interest, wanting them to engage with learning. The question he had when he considered including the Scratch game-making based learning project in his class was, How can a teacher assist students to get into game making quickly and arrive at a satisfying finished project so that this process of learning is rewarding to the learners, while providing them with the skills and concepts of programming as a tool for problem solving.

Ms. Moore's use of Scratch is designed to move students beyond game making and into the many other uses of Scratch they surveyed on its website. As I indicated in Chapter 1, users can work on video games, interactive newsletters, virtual tours, birthday cards, animations, interactive tutorials, and more, using Scratch (Ch. 1, p. 20). Further, students can create an interactive or animated presentation instead of the traditional written papers or Power Point presentations. Moreover, students learn to use their imagination and think creatively within the skills of basic computer programming, mathematical concepts, art and design, and problem solving (Ch. 1, p. 21).

Mr. Snow and Ms. Wood stressed the game-making learning process. Ms. Wood expanded her view on game-making based learning to think like a game maker as well as game player. According to Ms. Wood, the game experience, while interacting with the computer, is beyond the excitement of playing. Students learn how to think and plan their ideas based on not only their own thoughts, but also their thoughts about the interaction with players. For example, what age group would like to play this specific game, how do I help the players understand the instructions of playing the game, how do I keep the players engaged with playing the game, how do I know if the players enjoy playing the game, and so on. Mr. Snow said the interaction between a game maker and player and how the player's reaction affects the game's plan need to be a part of their thinking.

Mr. Snow underlined the important lesson of logical thinking while learning to make games. Students performed logical thinking while working on the programming for an animation or specific interaction in the program. In Chapter 4, I applied Albrecht's

(1984) definition of logical thinking as a process in which one consistently uses reason to come to a conclusion by establishing an understanding relationship between the problems with facts. This can be seen in the concept of having the game maker think of both roles—player and maker. Logical thinking, in the process of making a game on the computer with Scratch, is where students need to constantly think of the method of coding for their characters' movements and interaction. It is the technique of using mathematical statements or sentences together in the right order for creating an animation. Mr. Winter used the activity of writing down the statements for moving a water bottle from one area to another as a great lesson for learning the mathematical statements in programming a movement. According to Ms. Moore, students learn to pay attention and think more clearly about what needs to be done, and achieve the discipline of doing it step by step. Next, students need to consider several possibilities for interaction between sprites, sprite transition with different backgrounds, and so on. Programming is also an important problem-solving lesson these four teachers have emphasized in the use of Scratch.

When asked how they planned the curriculum, Ms. Moore and Ms. Wood declared that they look at the state as well as national standards to find the best of these guidelines they can bring to their students. The standards for the technology class stress enhancing students' critical thinking, problem solving, creativity, and learning to be a digital citizen. Both of them also selected options for consideration from conferences they attended. Further, Ms. Wood included in her planning students' level of interest and potential use in their high school studies and career path, whereas Ms. Moore and Mr. Winter talked about making a careful choice that fit this age of students. Ms. Moore, Mr.

Snow, and Mr. Winter mentioned they all enjoy reading technology magazines to learn what is being examined in the real world and what might be useful for students. All four teachers emphasized they try to keep updated lessons suited to contemporary life in the curriculum. Mr. Winter said that the scheme is to integrate updated programs and trends into curriculums to meet the need at the time and place, and students can then engage with the world around them. In this regard, Ms. Wood, Mr. Snow, and Mr. Winter stated they sometimes have to modify the curriculum, because either the standards change or they need to bring up-to-date programs to their teaching in keeping with the context of life today.

When Ms. Moore and Ms. Wood highlighted the lesson on becoming a digital citizen and how students need to learn to be responsible for what they do or say on the web, I thought about what I had learned about digital citizenship and singled out these concepts in Chapter 2. The Internet and digital technology highly impact our lives, and we have developed new habits of reading and thinking. In the meantime, how we retrieve information, communicate with others, and participate in the digital age is a significant lesson (Ch. 2, p. 43). Mr. Snow has addressed digital citizenship on the website for the technology class, where he wrote, “Students understand human, cultural, and social issues related to technology and practice legal and ethical behavior” (Ch.4, p. 17). Ms. Wood shared with her students the necessity to make helpful and not hurtful comments, whether talking in a chat room on the web or speaking about other students’ work. Ms. Moore also shared that students need to learn to be safe in the digital environment. Students in this generation are familiar with the Internet and function very well with their use of the computer and mobile phone. However, they need to pay attention to how they communicate and retrieve information on the web. Usually, they are aware of not sharing their phone number or home address on the web, and Ms. Wood added that choosing a user name is also critical to maintain privacy. I strongly agree with Ms. Wood: Users need to consider the impacts of responsibility and safety, and be careful not to let other people take advantage of them in the web environment.

Before working on their own game or project, students usually learned to make a basic game. In Mr. Snow's class, students started with a pong game with his instruction. Mr. Winter's students followed a tutorial for a ball-collecting game. Ms. Moore's students learned to make a maze game with obstacles. Students in Ms. Wood's class worked on an absolute maze game. Ms. Wood commented that although Scratch is not a complicated program, students are usually willing to continue the challenge and advance once they feel comfortable with the first activity. The maze game helped students become successful quickly and get excited for the next lesson. In Mr. Winter's class, following instruction is pivotal, and students took instruction from the tutorial for their ball-collecting game. Mr. Winter stated that students learned from instruction, because it helps them start thinking about the game-making process and the variety of tools they can use in the program. He believes a teacher needs to break down the operation of the game and explain its components to students, so they begin to think through the application from the concepts to the actions. In this way, students build a foundation of knowledge based on exploration, instead of the direct command from the teacher. Such teaching and learning instruction is different compared with the traditional classroom.

In my observations, at the beginning of the game-making lesson, all four teachers also showed students games from a selection of professional games or students' games from classes of previous years. Mr. Winter explained this is a strategy to capture students' interest and attention. Students would understand what things they could do thereby engaging them with the learning process from examples they may know or aspire to learn from their predecessors in class.

For the final task, students worked on an individual game but usually followed their teacher's broad directions. Ms. Wood said students might go wild if she lets them do whatever they want. Ms. Wood, Mr. Winter, and Mr. Snow usually kept the topic of their game geared toward the direction of an instructional game, for example, games for teaching math, a second language, pop culture, and so on. In choosing their topic, a number of students thought about their experiences in other classes, while growing up, or living in a second-language-speaking family. The instructional games teach students to achieve a higher level of thinking about what a game can do and how they can use this knowledge in other areas of their lives. It also helps students think about the full range of options and events as they approach one problem to another. Mr. Snow kept reminding his students that the best games convey information to other people in a joyful, fun, and engaging manner. Regarding his philosophy of learning, Mr. Winter said, "If a learner had fun, he/she participated in learning." It then becomes the joy of learning itself and the joy of learning to make games. If a student enjoyed making games and learned from its process, he/she was engaged with learning. If a game player enjoyed playing games and learned from its process and content, he/she had his/her hands on the actual learning as a participant. The objective of this learning process is to help students connect with the actual learning and become eager to learn.

In Ms. Moore's class, most students did not work on an instructional game for their final project. She encouraged students to think beyond a game. However, students all stayed on a game-based project. I wonder if it is because the projects people shared on the Scratch website were usually game-based projects, and students had then restricted their view accordingly, or perhaps their mind was eager to *make* a game instead of always *playing* games. In spite of that, students would work hard to think of a game unique for themselves, and that is also what Ms. Moore mentioned when discussing the freedom students enjoyed in her class. Students were encouraged to practice their creativity in choosing what they wanted to do for their own projects. There was not a minimum or maximum requirement in each project. Ms. Moore expressed the critical need for the working process to propel students to obtain the knowledge they reach from learning experiences versus their obtaining knowledge from a prescribed number of pages, steps, or lines of code. Students needed to stay with the learning pattern of listen, think, plan, communicate, work, test, and more work. Ms. Moore commented, "I like to listen to students' plan and watch how the students solve problems based on the individuals' intentions and scheme." Learning in the digital environment is not one-way teaching and learning. Learning by doing facilitates participation, expects interaction, connects with the person or material via a dynamic exchange, and deepens knowledge through active and extended engagement (Ch. 2, p. 84).

Ms. Wood uses her web page on the school's website, sharing lesson plans, useful resources, such as website links, and a brief introduction in which she discusses a background range of topics, from her art production, technology, and the yearbook to gifted classes. During my observation, students checked the resource links on her web page often. Mr. Winter and Mr. Snow also have web pages shared on the school's website but only for school use. The headline on their web page caught my attention: "Technology is open to all students. Students will have the opportunity to explore a variety of media and applications that involve the use of multimedia technologies." The four teachers whom I observed in this study all give this principle great importance and want to teach students as much as they can. Ms. Moore explained that there are many tools out there; exposing students to these programs and showing them how to use such tools in their daily lives becomes a continuing and key element of her teaching (Ch. 4, p. 99). Further, she prepares students with what they might need and helps them keep up with the pace of life. She does not use a web page for communication but teaches her students a series of applications on Google and keeps up her communication with them through e-mail, Google calendar, and Google document.

In Mr. Snow, Ms. Moore, and Ms. Wood's classes, students would get a chance to play other students' games at the end of each project. In Mr. Winter's class during my observation, students were only scheduled to meet every other day during the 4 weeks used for the Scratch project. Given this short time, students did not have the chance to play other students' games; but from my observation, they occasionally played each other's games during the class period regardless. This behavior, an expectation of constructionist theory, reveals levels of engagement, willingness to continue learning, and pride of their accomplishment (Kafai, 2006). Students also evaluated other students' games while playing games in Mr. Snow and Ms. Moore's classes. In Mr. Snow's class, students wrote comments for the six questions he prepared for them on Google Docs. Because there were 30 students in his class, it usually took 3 days to complete this evaluation process. From my viewpoint, these questions were primarily about if the game maker provided good communication and relationships with the players. The questions addressed if the game is easier to control, if anything is missing or confusing, and the game player's opinion about the graphics for sprites, backgrounds, and stories. In contrast, Ms. Moore's evaluation sheet was more about the strategy of the game and the relationship as seen from an understanding of the actual programming. The questions regarding strategy asked if there was an introduction or conclusion page, any sounds, and a green flag or other icon used for properly starting the game. The questions about relationships with the player addressed if there were any questions or dialogue with the player, challenges, opinions sought from the players, and other interactive elements. Ms. Wood did not let her students do their own evaluations, but she shared with me her grading requirements. She focused her grading on four areas: creativity and design, presentation, story, and game play. Because her background in digital art and as an art teacher is also one of her teaching focuses in the school, her personal interest is in the characters, backgrounds, story design, and final visual presentation. Further, she is concerned about organization and skill building, which are also components of design learning and learning for this specific lesson. Technical quality is of course stressed in the game-making lesson. Despite that, the grading category of story caught my attention. Within this category, Ms. Wood focused on engagement, provoking thought, player's self-investment, and education. The notion of provoking thought is captured by the question, Does the story provoke questions and thoughts that encourage an exploration? For player's self-investment, the question is asked, Is the player properly invested in the character he/she is playing? The responses to these questions required earnest collaboration and deep thinking. Ms. Wood only marked on each list of her evaluation forms from one to five—between *not yet* and *exceeds*. I would be curious to learn how a student might respond to these questions.

Besides the game-making based learning program with Scratch, Mr. Snow and Mr. Winter also have taught applications, such as InkScape, Photoshop, GarageBand, Sound Editing, Quick Time, iMovie, and Microsoft Office. Ms. Moore stresses several applications using Google, Microsoft Office, and a digital poster design project. She certainly agrees with Mr. Winter that the Microsoft Office program is not only for typing, and students need to know its whole aspect for future use or for incorporation with the tasks of other subjects. Mr. Winter believes that it is compulsory to teach students the fundamentals, and students can then interpret the tools for specific application in real life, once they explore more. Last year, Ms. Moore also had students view applications and resources on a mobile phone. Ms. Wood focuses on adeptness with sustainability and design programs, such as 3D architecture and Adobe Flash.

When Mr. Snow said the challenge is to keep all these new creations up to date for students, he was commenting on one of many challenges he faces in technology. Both Ms. Moore and Ms. Wood are of the opinion that it is not a sign of weakness to learn with and from their students, thus their discussion and learning together as positive attitudes in learning in modern society. It is well-recognized that digital media and technology are changing rapidly, and students hold varying views from their teachers of these technologies and their use. Mr. Winter hopes the lessons he provides in his class will assist students to consider their use for the future. It was very important to my study to better understand the intent of these teachers according to their personal and professional beliefs. These teachers are not new to teaching in this field; they hold a great conviction in the promise of technology and keep learning to provide the best path for their students. I was encouraged to hear Ms. Wood talk about her aim for lifelong learning and how glad she is to see when students get excited and want to learn more. Ms. Moore indicated her wish is to prepare her students for any possibility in the future. If these students grow up in the digital era, we, as educators, need to consider the best uses that fit their interest and capability to further enhance their commitment to and engagement with learning. The integrating of digital media in their formal learning might inspire their own innovation to the "next big thing".

What Happens in the Classes Through the Use of Digital Media?

In Chapter 4, I created descriptions of each classroom to help portray what took place in this context. The goal was to see how the teachers and students in these middle schools were interacting with digital media and game-based teaching and learning. The goal was to document in detail how these teachers' intention to design their curriculum and students' "competency" were consistent with this learning path. According to Rosen (2010a), educators need to understand how students are different in the ways they value and reach a level of proficiency with digital media and technology. It is not enough to see or know that students are capable with the various uses of digital media and technology. Educators also need to consider both applying techniques that are authentic and in style today in order to achieve ways for current learners to find the forms of digital media best suited to the tasks at hand, as well as how students receive and develop their own learning.

Today, digital technology in some schools is, on some level, just obsolete computers sitting in the classroom, leftover from earlier times when grant dollars and other funding were more plentiful. Current students prefer to use the entire library of digital tools, whether an individually owned mobile phone, iPad, iPod, or digital computer at home or school. Corsaro (1997) insisted that students' learning is not just adopting and internalizing what is given, but also reinventing and reproducing it as they negotiate, share, and create with others. According to Buckingham (2007b), technology apparently allows students to become actively involved in the learning process rather than passively receiving information. Digital media and technology create a more authentic mode of learning that connects students to contemporary society. Under a teacher's guidance, students are capable of understanding, making sense of, and communicating concepts, as well as strengthening ideas through a greater use of the digital devices pervasive in their lives. As interpreted in the first research question, the four teachers I scrutinized for this study all indicated their goal is to assist students to become proficient with digital media and, in turn, function and compete in modern society. Three of the four teachers, Mr. Snow, Mr. Winter, and Ms. Wood, have computer labs as their classroom, and students can come to use the computer before and after the regular class schedule as well as at their lunch break. During my observation for this study, students came to use the computers for their homework, in search of information, or entertainment with friends.

In each of the classrooms of Mr. Snow, Mr. Winter, Ms. Moore, and Ms. Wood, students came in and turned on the computers immediately upon their arrival. In Ms. Moore's class, students checked their e-mail and the Google calendar to learn more about the learning agenda. In Mr. Winter's class, students usually practiced typing on a certain typing program for 10 minutes. In Mr. Snow and Ms. Wood's classes, students logged-on to particular programs and worked on a specific project. And, while the day-to-day tasks were managed with the computers at hand, there was real work being done that was project specific. During my observations, students were comfortable to log-on to Scratch and started working the process of their projects without the teachers' instruction. Many scholars believe game-making based learning amplifies a more interactive, open-ended, and student-led style of learning (Buckingham & Scanlon, 2003; Wellington 2001). Further, game-making based learning requires students to work beyond the typical question-and-answer project in both the class and for their homework—it is believed these techniques encourage more engaged learning and extend the classroom day. Game-making based learning organizes learning in deep and effective ways (Gee, 2008), while promoting the value of learning by doing.

Construction of a Scratch game is designed to assist users to learn about game strategy and basic programming skill. In the course of one or two class periods and with a teacher's guidance, students acquired the basic tools required of Scratch. The teachers usually prepared simple game exercises to help students become more comfortable with the Scratch environment, for example, maze, ball-collecting, and Pong games. Once students were ready to make their own individual game, the storyboard or planning was required of the learners in Mr. Snow, Mr. Winter, Ms. Moore, and Ms. Wood's classes and then shared with these teachers. Basically, students needed to show the teacher the character (sprite) used, backgrounds applied in different scenes, and the operations required in keeping the game going per their plan. According to Mr. Snow, some students were eager to make a game and might think it would be easy to do whatever they wanted, but there is a lot of thinking and planning involved and the storyboard process helps them organize their thinking. Without planning, students would soon discover, “That is what I want to do for my game; how come it is not working?”

For example, how does the player want the characters to move and what is needed for that movement? How does the player use certain keys to play the game; should he/she use the space bar, or wait a few seconds for the next activity? However, there were a number of students who either did not embrace or did not understand the advantage of working on their storyboard and did it solely for the course work requirement. In Ms. Wood’s class, students use the storyboard or sketch technique from the previous project or in her digital art class. The purpose is for students to look upon the storyboard process as part of their practice in constructing a game and, as applied to other tasks, organize and plan their thoughts.

A storyboard is a graphical expression of a proposal. It is an exercise where students practice their thinking to have a clear understanding of the topic, purpose, sequence, and operation of their individual game. The students I observed all had to work on the storyboard and must have their teacher’s permission before starting to work on their game. Ms. Moore and Mr. Snow required their students to explain their imagination and the strategy of their storyboard. Planning is a vital stage for a successful project. Ms. Moore asked her students to provide a good description of their games, from beginning to end, as well as the title, characters, interactions, levels, backgrounds, transition, and more. Students individually spoke about their plans to Ms. Moore, once she had received their plans through the e-mail and had reviewed them.

Ms. Wood indicated that doing a storyboard helps students put their thinking on paper and allows them to see what they want for their game, ahead of the plan for actual coding. Mr. Snow declared that game makers could then more easily see what they want for their games and make it through the entire process from beginning to end. Ms. Wood repeatedly commented that it is a good habit to sketch the ideas before starting work in the computer. Often, it was common for students to want to include many tasks in one game or make a higher-level game filled with concepts and programming that was above their current skills. The teachers' job is to guide them in the right direction. With the storyboard, teachers can help students see the scheme of the game and provide suggestions to break the game down to a less complex game if needed. In the game-making project, students usually commented about their challenges in coding. However, the primary challenge is about putting more into what they thought and translating that to a realistic plan. Mr. Snow, Mr. Winter, and Ms. Moore stress this is the process of learning logical reasoning. Ms. Wood considered the linear thinking for each subject, along with the operation of non-linear thinking, in order to incorporate all individual elements together for a whole interactive project. Learning in the digital environment is used to move beyond rote learning and acquire the knowledge to apply and re-apply skills and concepts in different situations.

Often the process of planning and creating the storyboard prompted much conversation amongst the students and with Mr. Winter, as well as planning the conversation between game and players intrinsic to a good game. Mr. Winter explained the conversation for him is a dialogue between game maker, computer, operation, movement, and the player. At the least, it is a first step toward understanding communication in the broader sense. Ms. Moore always encouraged students to speak several times of their thoughts to help them understand what they want for their game and helped specific students who were confused about the coding. When students are capable of explaining their thoughts, they understand the objective of each structure and work step by step in this direction. I observed the same strategy in Mr. Snow's class. Sometimes, students needed to redraw the storyboard to provide more details, and he explained that this was his way of prompting students to think more thoroughly about their story. Mr. Winter contends that students learn through this medium to communicate with people who might not think in the same ways they do. He pointed out that the project is actually not only about making video games but also about a learning process towards communication and problem solving skills.

According to Candy and Edmonds (2000), communication advances the creative process. It is critical to challenge a variety of different thoughts and situations, including problem solving, in order to make a collaboration productive, resulting in harmonious fruition of the communicators' vision. In daily life, we communicate with pen and paper, talk with people in person or on the phone, or create an e-mail, as is so common today; but when, as users, we have the opportunity of making a game, the feedback we get from the player may simply be if this person likes to play the game or not, or if he/she can understand the objective and instructions to continue playing the game with enjoyment. How to collaborate is an important lesson (Candy & Edmonds, 2000). Collaborative communication reflects a different way of thinking about a problem and finding a shared vocabulary, with respect for the perspectives and aptitudes of different players.

While learning to make games, students learn to build a bridge between the game maker, the computer, and the players. Once game makers put all these plans into the program, they need to figure out how to tell the computer to do each task by using proper and logical instructions in the language of the program. As mentioned, it is coding that most people consider the greatest challenge in making a computer game. Students learn to think of each movement and character step by step, the interaction and transitions between characters and characters to backgrounds, and more, depending on the stories. Ms. Wood believes the concept of the movement of each character is an example of linear thinking. The moving bottle exercise in Mr. Winter's class and his illustration of a boy's dressing up for his grandmother's birthday dinner represent great examples for linear thinking about a simple movement in animation. However, the interaction or transition between characters and characters to backgrounds constitutes non-linear thinking. Game makers need to examine not only the coding for individual movements but also multiple lines and blocks of coding for the interaction between each of the sprites and each movement. Game-making based learning manifests many attributes of effective, collaborative and consequence-based thinking. Such attributes support not only problem-solving thinking in one context, but also computing thinking for interaction between each element.

Mr. Snow singled out the process of using logical thinking while planning and learning to make a game. The plan for making a game is a highly sequential process. If the students did not comprehend the concepts, procedure, or operational and programming facts in the process of making a game, they would not achieve the reward of making a game. While making games, a maker does not have to start making a game from the first scene but can build the action from different approaches and constantly consider all possibilities for the game he/she plans. This is one example of how the learning process in the digital technology class is very different compared to that in the traditional classroom. In the context of non-linear thinking, students learn to plan the statements for interaction between the characters and characters to background and virtually all the computational elements of their game. In the meantime, students plan for the players' valuable choices for different game levels; the continued tasks and rewards are then based on this plan and the players' choices, or may even incorporate surprises based upon a movement or combination of actions.

This is the learning of problem solving as referred to by all four teachers. Some students would plan a very complicated game on their storyboard, but the problem might be too complicated to solve on the computer. Balancing their ambition with this frustration was an important part of teaching. Students first need to think what they want for their game and how it works, then how they can fix the problem to make it work. It is a very cogent example of continuous evaluation, and thinking and learning about the problem-solving process. Every day, students came to class to work on their project, fix problems, and talk with their teachers or friends in the class, subsequently working and re-working to fix the problem they may have encountered and building their game with the new insight and knowledge they acquired through this learning and shared process.

Mathematics is a related lesson learned while making games. Students practice their math skills without being consciously aware they are using math. The teachers also mentioned they usually do not address the fact that this is a math lesson while working on their game-making project. There were a number of students who did not like math, and all four teachers pointed out that a recognizable math lesson would discourage students' interest. The tough challenges they want to address in their projects ensure that they would soon realize the necessity of using math in making games. In fact, the lesson of the x and y coordinates is the first concept of movement for the characters on the stage, and both. Ms. Moore and Ms. Wood taught about it the second day. Mr. Winter used the bottle exercise to help students' understanding of movement, following the use of degrees and the four directions on the compass, and asked students to write down, step by step, a statement of the movement of the water bottle from one table to another. Students learned to define the direction and coordinates, while shifting their bodies and the water bottle are then referenced to the compass points on the walls of the classroom. Further, students learned how to use numbers to express the speed of movement, because all these concepts were based on math, giving them a new way of expressing mathematical ideas. This was the first programming lesson for many students. Students needed to understand the movement from one location to another, which depends on how the statement is given to the computer. Ms. Wood kept reminding her students about the importance of writing a clear statement, because the computer only does what it is told to do. Mr. Snow agreed that he can only show students the basic math skills and logical reasoning—they have to absorb it and then apply it to their games. He explained, "Once students explore more, they would have fun to make a more complicated game with a high-level use of math." In my formal and informal conversations with students, some students conveyed that they understood they were using mathematical thinking while making games.

Mathematics is certainly an integral part of making games, because it involves logical thinking and supports the development of problem solving. While making a game, students practice logical thinking and the use of their math knowledge for the movement in animation, while trying to solve problems in their mind and connect the game maker and player within the game itself. For example, many people play games but do not get the chance to think about "variable" or "if" and "if not" statements until learning to plan a game. Most of the time, the game makers need to think about the choice of "next" as an action for the character based on the story, backgrounds, direction, and so on. Within this process, they practice math and logical thinking without actually thinking of the work or encountering the intimidation they might otherwise feel in the study of mathematics.

In this study, students usually did not have problems thinking up a topic for the game they wanted to make. Basically, according to the interviews with students, the topic choice was whatever they were interested in at that point in time. Jennifer told me she saw an owl in her backyard and she wanted to do something related to owls. Eric spotted the darts and target in his room at home and thought it would be a good subject. Students told me they think choosing a topic in this way is because they are usually full of imagination at this age. Many students showed their considerable capability for creative thought and imagination. With the organic act of creativity, their imaginations were stimulated, motivating them to accomplish their project with more personal and meaningful attachment and commitment.

Many students at this age have played a number of video games on computers or devices, such as the iPad, iPod, or mobile phone, and they get inspiration from the games they play in their free time. Some students shared with me that looking at other people's games, whether a friend's game in class or games on a website, helped them think and overcome their limitations. Some students liked to discuss their ideas with friends in school or with family members at home. There were several students searching for their own ideas while playing other people's games on the Scratch website or the games they liked to play. Usually, students liked to talk with their teacher for suggestions. Again, the process of planning is critical. Ms. Moore expressed that she needs to help students understand the necessity of adhering to a simple plot for their games and remind them not to make it too complicated. The teacher's guidance must always be a positive influence to prod the students on to triumph. Besides checking the students' plan and work process every day, the teachers made comments to keep students motivated with the promptings, such as, "How about keeping this idea for the next project?" "You have a very short time; do you think you can finish this complicated idea?" Learning from the basics towards higher levels of difficulty helps students establish a good foundation. If there were students having similar thoughts, teachers like Mr. Winter and Ms. Wood would suggest these students discuss their thoughts with like-minded students, or the teachers would speak to the group, providing further inspiration. Sometimes, when a teacher talked with one student, other students would come to listen to the conversation for their own insight.

In a game-making based learning environment, students also learn by watching and playing other people's games for inspiration, game strategy, and coding. Several scholars commented that students learn to think by playing games. In playing games, players are doing this work explicitly, openly, and socially in order to explore particular roles, while understanding the rules, roles, and consequences of particular places with which they might not be familiar (Shaffer, 2006). The four teachers in the study certainly agree with this statement. Ms. Wood gave students some useful links to game websites, and Ms. Moore encouraged students to play games on the Scratch website to expand their own thoughts. Students get exposure to new concepts by viewing different games and then strive on their own with targets in front of them, based on what they have seen as possible. It is a rare occurrence that inspiration can just arise without coexisting with one's environment. While playing games, students can then think further about the implementation of these ideas for their own games. Making a movement on Scratch comes from the ability to properly code the programming. When students saw a particular game they liked and studied the coding, they could also learn the coding from these games. Mr. Winter said, "Once students figured out the game, they could apply it to their own work." Mr. Snow commented that students learn when they manipulate things, make mistakes, and try to figure things out.

Many students are independent thinkers. They learn more by exploring various possibilities and thinking on their own. When meeting a challenge like coding, some students frequently ask for assistance, but others prefer to think on their own. I observed that some students sat on their own in front of the computer, testing the coding again and again or looking at the coding from existing work or from the web. Some students would get together with friends sitting next to them to discuss the coding for their games.

In these digital technology classes, students usually do not have homework. The only homework was planning a storyboard. However, some students would work on their project in the evening or weekends at home. Sometimes, I would hear students bringing questions to their teachers on Monday as evidence of their weekend thinking and studying. Learning happens while students work and think, and then raise questions. One way to know if a student is learning can be easily observed if he/she can speak about his/her work or has any questions regarding his/her project. This is one way of showing how knowledge is constructed by the mind of the learner. Game-making based learning with digital media technology stimulates students to think more from their basic ideas and build upon the original thought. Further, they continue to have more thoughts for their project, discuss them with their peers and teachers, and enthusiastically work without boundaries toward the vision of their imagination.

In class, students always helped each other by providing feedback, comments, or assistance. Teamwork aided to intensify the quality of an individual's work. Normally, students who helped solve coding problems with each other do not solely rely on the teacher's assistance. Ms. Moore would remind students of the help she can provide as well as the help they can get and give each other. Often, Mr. Winter and Ms. Wood would address a specific student who knew the solution, asking him to help another student with a related problem. The concept of peer teaching is very important to these tasks. Students inspired each other and were pushed to a finer and higher standard.

Students worked on a pong game in Mr. Snow's class, a ball-collecting game in Mr. Winter's class, a letter animation and a maze game in Ms. Moore's class, and a maze game in Ms. Wood's class. Even if students worked on the same assignment, they all had different plans for their game and process, speed, story, artwork for the characters and background, and even the use of sound. Individual students showed their own personality and viewpoint in the process and completion of their game.

In Ms. Moore's class, once her students completed some simple tasks, she always encouraged them to think of more ideas to enhance interest and the factor of entertainment for their games. For example, the colors, shapes, texts, possibilities for animation, or sound could be different from one game level to another. The students' imaginations were continually thinking about all these considerations in making more complex or involved games. Students achieved their learning by discovery and practiced step by step every day. According to Kafai and Resnick (1996), "Students do not get ideas, they make ideas." Many students constantly thought, planned, and worked to find ways of making their project a success.

A number of students liked to incorporate sound or music into their games. Because Mr. Winter had taught sound programs, such as sound studio and GarageBand, and Ms. Wood had taught GarageBand, they were able to offer their experience to some students, who then recorded their own sounds or modified stock sounds for their own use. Some students would use InkScape in Mr. Winter's class and Photoshop in Ms. Wood's class to create their own artwork or restyle the pictures of their characters and backgrounds for the game. The tools and functions in the computer or other technology equipment, such as digital cameras and scanners, stimulate students to contemplate a variety of possibilities for application to their projects, because these tools promote their imagination.

Whereas Ms. Moore kept reminding students to save their files, students in Mr. Snow, Mr. Winter, Ms. Wood's classes usually had their flash drives with them. The flash drive is required in Mr. Snow and Mr. Winter's classes, and I noticed many students kept their flash drive with their student I.D., displaying a sign of importance. Saving a file regularly to keep safe the up-to-date work is also a pivotal lesson in the digital world. As mentioned earlier, once the file is lost, the solution is usually rebuilding, which would not be an enjoyable process. When Amy, one of the students, told me she preferred to e-mail the work to herself for working at home or school, she explained that she worried about a computer virus while transferring files through a flash drive. I assume her family members or other teachers in the school taught her this information. There are many lessons students are aware of just by being a member of this digital society.

At the beginning of the game-making based learning course, students in Mr. Winter's class shared with me their excitement for the lesson of making games. Students in Mr. Winter's class knew of the upcoming game-making project as did students in Mr. Snow's class know beforehand about his specific project designed for game making. Yet, students in Ms. Moore's class did not know, before entering her class, much about the projects they would do. Students shared with me they thought it would be a good chance to use the computer, and it might be an easy course. But they did not know they would also learn to make instead of just play games. Students subsequently told me they were excited to work on more projects related to digital media and technology.

Students in Ms. Moore's class were exhilarated by their use of Microsoft and Google applications, besides typing. In Mr. Winter and Ms. Wood's classes, students were stimulated from their growing expertise, arising from the transition from still to animated art. Ms. Moore spoke about the creative and intellectual freedom students enjoy in her class, which they do not have in other classes. They can use their creativity to explore more of what they want to do. For example, when students wanted to add a score bar or wacky sound to their game, she supported them to achieve what they wanted. Such support provides a reward that results in self-encouragement. Students enjoy having the chance to work with the computer. Moreover, they are blissful in the freedom to plan, decide, and discover their own learning while working with the projects under the teacher's instruction. This is the blessing of constructionism that Kafai and Resnick (1996) talked about. With their manipulation, students make a complete and final production, which they can then share with friends and family. Ms. Wood said that students are very proud of themselves, as is made evident by their sharing.

Ms. Moore pointed out, “The only limitation in this class is time. I need to set up a deadline for each project. Otherwise, students would keep exploring more and want to add to their project.” Usually, Mr. Winter, Ms. Moore, and Ms. Wood kept to a 4- to 6-week timeline for the game-making based learning project. Mr. Snow used 3 to 4 weeks for each game project. During my observation, students in Mr. Winter’s class wanted to continue working on the computer well past the class time, and many times Mr. Winter had to shut down various students’ computers from the server of his computer. In Mr. Snow’s class, students sometimes kept asking questions, eager to extend the length of the class to solve the problems of their projects. Students in Ms. Moore’s class had to ask for a special pass to continue working after the regular class time. Mr. Winter often remarked how time affects students’ process of learning. Some students needed more time because the way they processed the tasks was different than the norm. A teacher needs to reflect on the individuals’ needs in the class within the constraints of the curriculum. If a student needed more time to complete the project, Mr. Winter would let this student continue to work as needed. However, I observed that students in these four classes usually completed their project during class time. Few students used extra hours, because their enthusiasm and sense of competition with their classmates served to motivate them to complete it both on time and with finer quality. It is well documented that students’ intrinsic motivation and task orientation are related to positive motivational outcomes, such as more effort and persistence, more effective learning strategies, and better school results (Dweck & Leggett, 1988; Elliot &Dweck, 1988; Nolen & Haladyna, 1990; Phalet, Andriessen & Lens, 2004; Pintrich & De Groot, 1990)

When the time had nearly arrived for their work to be done, many students were ready to wrap up their projects. Some were testing friends' work and some were busy working on sounds with their earphones on, while some were still focusing on their project, pushing themselves for their game to be of the best quality. Because games themselves are competitive, that sense of competition is often seen in construction of the game as a form of synergy with the game concept. Some students were still asking their teachers questions or testing their final work. These students wanted to push to the last minute. Students then got chances to play other students' games in the last one or two classes. This was the activity students enjoyed most.

In summary, what happens to the classroom dynamic through the use of digital media?

- Students were excited with the chance to use the computer and usually started working on the processes of their project immediately upon entering the class.
- Teachers' organized curriculum and instruction guided students to adapt the use of tools and explore the possibilities towards meaningful projects.
- The planning and storyboard process helped students organize their thinking and develop a clearer understanding of the topic, purpose, sequence, and operation of their individual projects.
- The communication lesson between game makers, the computer, and players, reflected a different way of thinking about a problem cultivating a shared vocabulary with respect to the perspectives and aptitudes of different players.

- The practice of linear and non-linear thinking helped to enhance thinking of problems and solutions in new ways.
- The unconscious use of mathematics, which involved logical thinking and problem solving, occurred during the game-making based learning project.
- The students, as a group, provided assistance to each other.
- Game-making based learning with digital media technology stimulated students to think beyond their basic ideas and build upon their original thoughts.
- Students brought knowledge they had acquired from other subjects, projects, and software to the game-making based learning project.

How Does the Use of Digital Media Affect Students' Educational Experience?

Whereas many scholars have emphasized the potential of integrating digital media into education and a growing number of teachers have applied the applications to their classroom, some people might wonder if the reward of this modification is a possible "learning revolution" (Resnick, 2009). The advantage of digital media integration into education must be considered beyond (a) the ease of communication through tools, such as e-mail, texting, or social networking; (b) effortless information retrieval from the Internet via Google, Wikipedia, or Yahoo; or (c) the ability to organize presentations via tools, such as Word or Power Point. Digital media and technology relate to education in many ways. Landauer (1988) emphasized the way in which people consider education may be associated with their interaction with the entire world. The collaborative efforts of digital media technologies and educators today combine these concepts to support all facets of education, from the use of fundamental application to better ways of engaging and retaining learners in their study of the essential subjects in the classroom. Indeed, digital media and technology have become an insight service to help people know, think, learn, inspire, and create.

For this third research question regarding how the use of digital media affects students' educational experience, I discuss the five conceptual frameworks that have guided this descriptive study. These elements include (a) multifaceted thinking, (b) motivation, (c) engagement, (d) experience, and (e) creativity. All represent significant concerns in the context of learning. They are separate subjects but must be integrated into today's curriculum to best mold students' attitudes and behavior to become eager to learn, keep learning, and reflect upon learning.

Multifaceted Thinking

The value of multifaceted thinking is learning how to gain innovative views from a full range of environments encountered by learners–from personal experiences through all the many situations we encounter. It involves absorbing all thoughts and breaking them down into their component parts in order to gain insight and, in turn, affecting an outcome and development of one's own thought. This study discusses students' multifaceted thinking while within the digital media environment.

In modern society where individuals no longer follow a singular track but embrace a multitude of inputs and outputs, contemporary life with digital media affects the individuals' practices, diverse choices in decision making, and all forms of representations used in idea, thought, and action. For example, multifaceted thinking encourages the search for new information in new forms and formats of information gathering, processing, and sharing, as mentioned in Chapter 1. Multifaceted thinking is processed by the selection of the very medium itself and the users' ability to think and choose his/her own forms of expression.

As matter of fact, while meeting addressing the questions of their study, work, and life, people tend to choose to search the Internet by using the Google search engine instead of going to a library and checking the information in books or using forms of more analog research. In this study, students revealed their love of researching for information they wanted to know on the Internet, from their school homework and upcoming movies to their shopping list. Their use of mobile phone texting or Skype has become more common than speaking on the phone. Indeed, digital media and online communication have become pervasive in their lives. Once students find a way to be together with their peers via their use of digital media, they integrate new forms of thinking within informal online practice as their new characters and mode of communication. This ready availability of multiple forms of digital media in varied contexts of everyday life interacts with students' growth in thinking and self-identity construction.

In the beginning of the digital technology class, Ms. Moore taught her students a series of Google applications, such as Google Doc, Google calendar, and the creation and use of a Gmail account. Throughout the semester of teaching and learning, Ms. Moore used these three applications to communicate with students and they with her. In Ms. Wood, she encouraged her students to keep a reminder of their homework assignment on their mobile phones. Mr. Snow made an on-line evaluation form, and students could type their comments and return it to him as a digital format file. Contemporary methods of experience give users the ability to transmit and receive information across a wide range of modes and sources.

The discussion with each of the four teachers on linear thinking and non-linear thinking in the use of digital media and technology is evidence of the basic thoughts people exhibit in the digital environment. In the game-making based learning project, students learned to write coding for one movement for one character, which represents the practice of linear thinking of writing scripts line by line. However, the way to complete an entire game is one where the game makers needed to know how to write coding not only for one movement but also for actions between characters, characters and backgrounds, win or lose strategies, and more, as they planned in their story board. Plus, the consideration of sound, text, graphics, and so on was used to heighten the entertainment factor of the project. Learning and constructing in the digital media environment and solving problem are contrasting outcomes, and learners perform multifaceted thinking while interacting both consciously and subconsciously within these questions. Mr. Winter spoke of how students learned step by step to establish a strong concept within the environment, because it helped them start thinking about the plan, process, and variety of tools they could use in the project. Thus, students built a foundation of thinking like multifaceted thinkers for their progression in work, and the enhanced multifaceted thinking in the digital environment intensified students' intrinsic abilities, instead of their solely following the teacher's instruction or directions from their textbooks. Students achieved the potential for success in their project by combining what they already knew with the discovery of how they could then apply this knowledge.

Learning in the digital environment forces students to evaluate a wide range of variables in completing their projects. Students learn to sequentially build their complex thinking from the basics to then more focused and driven techniques to reach the goal of their plan. This form of game-making based learning is a great example of modern learners' thinking in practice. This form of learning presents how a learner can prepare a work, product, concept, or process, or provide evidence of his/her thought in a logical interpretation.

Motivation

Motivated learners are easy to describe. They are enthusiastic, focused, and engaged. They are interested in and enjoy what they are doing; they try hard and persist in their learning over time (Garris, Ahlers, & Driskell, 2008). I believe the students who were observed in these four classes showed high levels of motivation to learn about digital technology and were excited about game-based projects as an entry to their learning experience. For example, students in Mr. Snow's class knew about the game-making based learning course, needed to have a higher GPA requirement to be accepted to the class, and worked very hard to stay in the program. Students in Ms. Moore's class had no prior knowledge about the course but were enthusiastic to learn more about digital technology. Ultimately, in both cases, it was their joy and excitement for the concepts of game making that served to keep their attention, motivation, and commitment.

Even if students were excited about the lessons in the digital technology class, they were nervous in the beginning. But their commitment led them to learn step by step and apply the skills they already had and were learning in order to achieve successful outcomes. The four teachers in the study made the point that students' motivation drove them to keep engaged with the learning experience. Once students found that it was not hard, they wanted to do more. Mr. Snow said, “The best motivation is coming from the students, not me, not grades, not their parents. It comes from them and their desire to learn the things they are interested in.” If students are motivated, they will learn and lead themselves to keep learning. Many studies have suggested that when students value a learning activity in terms of high task value, interest value, instructional value, future goals, and future perspective, the degree of their motivation to engage in the targeted learning activity significantly increases (Jang, 2008). Students show their sophisticated levels of self-regulation to understand what they are doing towards the goal, and achieve more than the traditional pedagogical method of lesson instruction, consequently having personal attachment to their project. For example, when students worked on their pong game in Mr. Winter’s class, they included the theme, background, title, and more, without the teacher’s instruction. Students in Ms. Moore’s class were eager to work on three or four progressively higher game levels, above and beyond the required standard.

Several researchers have indicated that using digital computers in education brings complexity to learning tasks and thus increases students’ motivation (Baker, Gearhart, & Herman, 1990; Rau et al., 2006). The use of this complexity and challenge has positive impacts on students’ attitude, performance, and satisfaction in accomplishing targeted learning outcome. When a learner is already motivated to learn something, it is necessary to ensure that he/she is actually learning. Even the most sophisticated instructional program will fail if students do not retain their motivation by achievement and reward to contribute to what they aspire to do. Accordingly, the four teachers in my study usually kept the length of each exercise or project short. Students normally spent 1 week for one exercise, such as a maze, or 2 to 3 weeks for a completed project. In a short time, students knew the aim of the mission and stayed motivated throughout the process. With the desire to learn, students are likely to engage with learning, establish a meaningful relationship for current projects, or establish intent for their future work. If digital media motivates students to learn, the utilities of digital media strengthen students' capabilities in exploration. Further, they want to proceed to a course of action to learn and construct their own knowledge from the new tools and skills they begin to master.

Phalet et al. (2004) debated the question of whether the goals to enhance motivation and learning regulate classroom behavior internally or externally. Externally regulated behavior is motivated by future goals, such as job requirements or material rewards. In contrast, internally regulated behavior is driven by motives that are intrinsic to the person, such as one's personal development or project. Most students I approached for this study stated their fervent efforts for this class and their projects are simply due to their interest in the subject of digital media and enthusiasm for putting forth the best level of endeavor. Two students in Mr. Snow's class, Ted and Josh, commented that their dream is to become a video game designer in the future. When students have or develop their own motivation for achievement, this is an excellent example of where students' motivation, task orientation, and intrinsic interest originate. Students who perform at high levels of motivation are usually challenged and curious, and specifically apply their attitude to academic behavior as well as a direct interest in the educational process. However, the use of digital media and technology in education not only is an appealing topic for learning but also challenges students to become personally involved in various learning practices.

This study showed students' sense of personal understanding and goals in education in the lesson using digital media. Students acknowledged their attachment to digital media and technology, and they were willing to become deeply involved and use it as both core and supplemental knowledge under the teacher's guidance. When educators are given organized and cohesive tools in digital media, as is central to life in the modern era, students can readily see the benefit of these tools, because such technology tools educate them for the future.

Engagement

In the Chapter 1, I described engagement as a form of participation that suggests students keep learning, be involved with the class activities, and actively contribute to the effort at hand (Ch.1, p. 13). Engagement also offers a broad look that may be a better indicator of students' achievement (Bunn, 2009). Bangert-Drowns and Pyke (2001) called engagement "the mobilization of cognitive, affective, and motivational strategies for interpretive transaction" (p. 215). During the learning experience, some students demonstrate varying levels of engagement—being more attached to some methods and tasks and losing interest in others, because this is natural to all people and not simply to students in school. The teachers' instruction and interaction are pivotal to assist the students' learning experience to be fully engaged with the subjects, their peers, and the class. In this case, I noted that in all four classes, a very high percentage of the students revealed fulfillment and discipline as they progressed the course.

During my observation, I spotted students being very quiet because they were intensely focused on their individual work, or booming in their conversations about each other's work in the classroom. These students were excited about what they were doing and pushed themselves to ever-higher levels of quality work. Although students spoke to me of the complexity in the coding for making an animation or as they used a storyboard to set down all the plot lines for a completed project, they came to the class every day on time and turned on the computer immediately to continue the process of their work. It was rare to see any student absent from class or sitting in the corner doing nothing. Sometimes, students might talk to one another about subjects in this and other classes, and Mr. Snow assured me that this noise was not bad. Mr. Winter said "If any student needs a break from the hard work, there is nothing wrong with it." Students are engaged when they are involved with their work, take up the challenges, and accomplish their work with curiosity, delight, and motivation.

Students often helped each other in class. Mr. Winter stressed that learning happens while they are engaging with and influencing each other. As Mr. Snow sometimes highlighted, "We work together to make our games work." Ms. Moore always encouraged her students to help each other. During my observations, I overheard students' conversations regarding coding, ideas for games, invitations to play each other's games, and much more. Making a game is not like writing a mid-term paper, and there is not only one technique for one successful result. The hard work of completing a project is made much more enjoyable when students work together as a team and are not solely dependent on the instruction of the teacher.

Engagement is seen in the students' genuine enjoyment in the learning experience. Ms. Moore's appreciation of her students' hard work, without complaining or giving up, is also an indication of her students' engagement in her class. The four teachers declared that when they see students have worked on their projects at home or brought questions to them, this is a sign of the students' engagement and commitment to learning. Successfully engaged learners identify the learning goal, install a strategy to bridge the aim and decode the problems, and are integrated in a meaning-making process (Bangert-Drowns & Pyke, 2002). I clearly noticed that if a student brought work home to show his/her family, this was one example of how he/she was genuinely engaged with learning and proud of his/her aptitude to the task. A good example of this was Amy, who sent her work to herself through e-mail and worked over the weekend and wanted to show her final project to her parents and younger sister. John also mentioned he definitely wanted to show his project to his family. The students I viewed were striving hard in their work and eager to share their work with others, because they enjoyed what they were doing.

The teacher surely plays a strong role in engaging students to learn. Ms. Wood always tries to engage with students by establishing a relationship with them and plans projects related to interests in their age group. Ms. Moore regularly communicates with students who have become confused with certain aspects of their work or lost interest. She wants to make sure her teaching helps to make every student want to keep learning and come to class every day. Mr. Snow also commented that if educators can lead students to be more engaged with learning and assist them to view the value of their work, these students would understand the intrinsic value of knowledge and application of the work they do and then become more motivated and engrossed. Ms. Moore wants her students to first feel comfortable with the learning experience, whether in her digital technology or mathematics class. Mr. Winter explained that when he saw students were happy with their work and attached to his teaching, that is his measure of fulfillment as a teacher. The teacher is certainly the basis for success in learning. How a teacher inspires students to gain the desire to be deeply involved in their work is pivotal to the learning experience.

According to Ms. Wood, digital media and technology are essential to keep students attracted to the subjects they are learning. The speed of accessing information and the effortless procedure via digital tools to prepare a clean presentation are different when compared to working on paper with pen. A project like game-making based learning brought interest and challenge to keep students focused on completing their work as well as achieving real learning. Students' enthusiasm often pushes them ahead in their learning and was evident in this study by their commitment to acquire the knowledge needed to achieve a better project. According to Mr. Snow, the challenge for making a game is about not only constructing programming codes for a game, but also how one combines all these learned skills to make the game work. From the beginning, when students first undertook a new program, they began to visualize both the whole and component parts of the required work process to the completion of the game. It is not only the motivation students have for making a game; they are also engaged to understand sequences, logic, rules, and concepts of the game that determine how things have to happen for it to function. All four teachers mentioned that their teaching strategy varies based on the individual. After Ms. Moore had assessed the strengths of her current group of students, she pushed them to apply more effort to their work, but they still had fun and worked very hard without complaint. Ms. Wood stated her favorite form of teaching is to open doors for her students to access knowledge in ways they choose, and accordingly, she is very focused on these particular ways of obtaining knowledge.

In the four classes I studied, some students chose to come to work in the lab after the regular classes, because they were attracted to using computers. These students enjoyed working on their homework or searching for information on the Internet, ranging from knowledge related to their homework to their favorite movies. In Ms. Wood's class, one student even chose to work on an animation of *The Tortoise and the Har*e in his free time. All of this is simply because these students cared and devoted their time to something in which they were interested. They enthusiastically cared and were committed to their work in their class activities. Further, they established their position in the digital environment and performance in the classroom by involvement with the digital media and technology-based approach.

Creativity

While talking about learning, Ms. Wood commented, "We work toward the creative solution." Mr. Winter stated, "I think all students are creative." Creativity is not limited to a product or process innovation. Mr. Winter stresses that creativity happens when students enjoy the process or experience in work, life, or any circumstance, whether they are solving a math problem or coloring a picture. The joy stimulates their mind in relation to and as a result of creativity.

Many students of this age already show their confidence to stand out and want to be different from the ordinary. One student in Mr. Snow's class chose a healthy meal as the topic of her game, and another shared her knowledge of movies, compared with her classmates' games about a lesson within school life, such as second-language or math learning. These two students chose their topic not for the specific school subject but for its value in sharing with others good knowledge while playing their game. When Amy shared with me her learning experience, she immediately said how much she wanted to be distinct from the others when she considered the subject for her game. There was an assortment of students in these four classes who worked at various levels of extra effort to magnify their project to a real sense of achievement. For example, many students in Mr. Winter's class made modified versions of the ball-collecting game—in one scenario, the game was on a basketball court, a different story featured a monster and monster-nanny, and in another version, the ball was a bullet shooting a brick at the top of a wall. Students in Mr. Snow's class also showed similar interpretations. The games were similar, but each one showed that individual students used their creativity and added personal attachment to the concepts developed for their game. It is truly a unique moment when the reader is given an "a-ha" moment as evidence of creativity. These students worked hard while practicing their creativity, whether by topic choice, content research, story planning, art effort, or interactive applications, all in addition to the use of technological techniques.

Mr. Snow's definition for creativity is, Taking things that are not related to each other and putting them together to become something new. When I saw students exploring new tools in the program or searching for interesting content for their projects, their amusement in their discovery inspired their creativity. Ms. Moore believed that creativity comes from exploration. For instance, students' reaction to the incorporation of sounds for their projects, once they had explored this function, brought their advancement of thought for its further use. Some of them recorded their own voices, while others created their own sounds in the GarageBand program. Ms. Moore also pointed out how students are encouraged to explore their desires, and creativity would be employed whether from their abstract thoughts or thoughts specific to the operation required in the program. She emphasized that their freedom is also a key to enrich and foster creativity. Students are free to explore whatever is in their minds and add special touches to their projects. Additionally, problem solving, effective communication, and desirable attitudes, such as cooperation, flexibility, adaptability, openness to new situations, and the valuing of knowledge and opportunities for their own sake, are developed (Ch. 2, p. 65).

Once students saw an interesting aspect incorporated into the work of their peers or teachers, they wanted to add it to their own work. Usually they altered their find to fit their projects or moved forward, adding compelling features they would discover along the way. Under that circumstance, I observed students were inspired by their peers' creation. For example, students were most fervent in using sound for their project. Also, students in Ms. Moore's class chose to use their handwriting or drawing in diverse styles, as compared to students in Mr. Winter's class who used the design tool of gradients, because Mr. Winter demonstrated this feature at the beginning of the lesson. Certainly the gradient color was a fun discovery for students, and it was used creatively as they chose colors for the areas of their designs.

A number of students revealed they think the use of computers sparks their creativity because of the benefit of a clean and organized output. Computers surely provide the efficient typing of documents, appealing Power Point presentations, or the calculating of math. Students also commented drawing on the computer would result in cleaner lines and shapes with chosen colors, and they could re-do their work as many times as needed to reach a level of personal satisfaction.

The teacher's assistance is pivotal in inspiring students' creativity. Mr. Snow's encouragement taught his students to keep thinking. Ms. Moore helped her students be involved and reflect on the video games they played at home, and the benefit from this was then included in their projects. She constantly searches for useful resources for her students, and Mr. Winter regularly looks for rewarding materials, lesson plans, and programs. Students learn to create their projects and be more creative, based on their teacher's contemplative plan, the learning process, and exploration, and they worked hard to realize their vision. As Candy and Edmonds (2000) stated, "Creativity is not accidental and by understanding how it works, we can learn how to encourage and enhance it" (p. 1) From this statement, many benefits can be seen of the teacher's instructional guidance and the proper use of supporting tools, such as digital technologies, to expand the creative process.

Both Ms. Wood and Mr. Winter mentioned they hope students would take knowledge from their learning in their class and bring it to other classes for more innovative projects and vice versa. In Mr. Wood's opinion, the ability to transfer knowledge from other classes or make connections to other subject matter and then combine these elements to a new or different idea is creativity. For example, a student created a story of a fish eating trash to point to the green concepts in our environment. Another student used his knowledge in chemistry for his project in this class in the making of a video game, and in the process taught players about chemistry. Still another student chose to create a new animated version of the story, *The Tortoise and the Hare,* in his free time. In their projects, students used their existing knowledge or researched for newer information to incorporate. The process of learning itself then influenced students to learn more about the subject besides using the digital tools. Digital media as a new form of presentation, like game-making based learning, employs the exploration of learning concepts with individual and collective knowledge, as people search for and achieve a deeper learning experience. Digital media and technologies have an influence that encourages individuals' work towards knowledge development with creativity, by practicing the use of tools, because it can make such structures work for individuals to put effort into the specific aspects of their work. An understanding of opportunities to underpin and buttress creativity is being pursued with the strategy of using multiple knowledge inputs and generating multiple forms of output for supporting individuals' work (Candy & Edmonds, 2000). The lesson and learning process from their chosen projects heighten students' views toward a global perspective.

In general, the discussion about creativity is usually suggested in the "Four P" model, which refers to the creative person, process, product, and press (Kaufman et al., 2008), as discussed in Chapter 1. The increased use of digital media and rapid change of contemporary life force people to continue thinking about the interaction between aptitude, process, environment, and social context, from individuals to individuals, or individuals to groups, or even an entire society. In this study, I was curious to learn the impact of digital media learning on students' creative thinking in action and if digital media provides a distinct form of learning in contemporary life (Ch. 1, p. 17). In the course of my study, the surprise and unexpected functions on the computer and its programs inspired students to continue thinking and achieve new and often unexpected results in their projects. Examples include when students heard about the idea of making video games instead of playing video games, when they heard about the usage of sound instead of silent animation, when they heard how they could make games to share their knowledge with other people, and so on. Certainly, the teacher's intention and the use of instruction are significant to the development of progress toward creative thinking into practice.

If digital media and technologies play certain roles to augment the limitation of human thought and action, a critical issue is how to use the tools properly and provide constructive systems to foster individuals' creativity. The demand is to reveal the limitation of existing technologies and open doors to developing new approaches and techniques. The tools are not the only element to be considered. Whether or not users enhance creativity in new ways may be significantly influenced by the conditions in which it takes place. How can individuals strengthen personal experiences in digital media and technologies in light of what is believed to be creativity in action in modern society? The involvement of creativity connects human attitude, behavior, and technological practices across the many perspectives of existing digital media technologies. The process of how one arrives at creativity is of great matter and import to collaboration. The way in which individuals explore their ideas and acts emerges during the process to form their explicit objectives. There is a significant role for collaboration—to generate and develop a concrete structure process and execution, then make decisions to support individuals' creative mind in action.

Experience

The first day I sat in Mr. Winter's class for observation, two students introduced themselves to me and asked about my experience in game making. This is one way these students showed their commitment to making a video game. Making a video game sounds more exciting than playing video games—even as they just begin to become aware of the process in making such a game. Students in Mr. Snow's class already knew they were there to learn to make computer games, and they knew they needed to have a higher GPA to be in this class. The students' attitude towards the idea of making video games was the motivation in the class.

Mr. Snow commented that he thought 27 out of the 30 students in his class were comfortable with computers. Some students in Mr. Winter, Ms. Moore, and Ms. Wood's classes shared with me how they used the computer for typing in the Word program, searching on the Internet, watching their favorite video, listening to music or watching videos on YouTube, or chatting with friends on Facebook or Skype. Many of them have personal access to a computer, laptop, mobile phone, iPod, or iPad. Before entering Ms. Moore's class, students only expected to use the computer, but they did not know what they would specifically encounter in this class. Students showed their wish to learn more about computer technologies, even if they had already experienced the use of the computer and Internet. Next, students exhibited their surprise when they were actually in the class. Before learning about making games on Scratch, students learned the various uses of Microsoft Office programs, such as Excel; a series of applications on Google, such as Google e-mail, Google Docs, and Google calendar; and the making of animated posters. When they were told to be ready to make a video game, students' eyes opened wide with excitement about what the teacher was saying. How could they make a game in a computer lab in school? By the end of the project, students were still excited about their capability and were eager to show family members their efforts in this class.

No doubt that making a video game sounds impossible to many people. Lately, many educators have employed the strategy of playing games in education. Yet, the scheme of making a game for learning has caught many educational experts and teachers' attention. Making games for learning challenges students to not only use new technological tools and learn how to make things of substance with those devices, but also develop their abilities in new literacy as a qualifier for digital citizenship. Besides the generally positive impression of playing video games they had, the skill of making games motivates students via fun but as a significant learning process.

The first job of making games is to craft rules and plan the plot, which results in logical thinking and communication experiences in learning. The four teachers in this study emphasized in their classes the keys of learning in these two areas. Logical thinking usually refers to a process in which one consistently uses reasoning to come to a conclusion. Communication offers up the creative process and is critical to challenging a variety of different thoughts and situations, including problem solving, in order to make a collaboration productive, resulting in the harmonious fruition of the game maker's vision. The collaboration of communication and logical thinking reflects a particular way of thinking about a problem and finding a shared vocabulary with respect to the perspectives and aptitudes seen in the digital age. During the individual class time, over the course of my observation, I was surprised by the change in students' perspectives and overall improvement in using Scratch, through the entire process from storyboard to completion.

In this regard, Ms. Wood said, “It is an extremely powerful tool and will excite the students if you use it in the right way.”

One very important observation I made, put in the context of these digital tools, was how the teachers’ attitudes in teaching adapted to the changes of contemporary life. When Mr. Winter learned about the Scratch program, he thought about how he would introduce it to his students via fun, engagement, and amiable instruction. All four teachers regularly attended conferences, read magazines, searched on the web, and discussed with their colleagues ways to collect the most up-to-date information and its usage to intensify their students’ learning experiences. Moreover, these four teachers modified their lesson plans differently, based on the aptitude of an individual or group or their experiences from the previous group. Digital media technology opens up new possibilities for the representation and presentation of information in ways that are better suited to human assimilation than methods previously available, and the teachers' ongoing research was key to best practices, as they grow through research, experimentation, the evolution of technology itself, and the students who use it.

The four teachers always encourage their students to speak of their thoughts for their project or share their work process and efforts with each other. Students were proud of their commitment and capabilities to help their peers. Students felt no pressure coming to class and actively participated in the class activities to heighten the quality of their projects. The only pressure came from the aims individuals placed upon themselves, wanting to achieve the very best for their own projects. Students understood the way to fulfill their goal was to work hard and complete their project as intended, always keeping an eye on the target. Several students used their free time after school or weekends to continue working on their project. It was not a requirement from the teachers, but their own desire to work towards their goal. Students worked on their projects with a genuine sense of fun and brought joy to their games and the future players, and I believe this was a key to their clear focus and dedication. Although many people might have contrasting opinions on using videos game in education, the students in these four classes always revealed their curiosity and delight to work very hard on the processes needed to construct their own game, collaborate with and play their peers' games, and strive to achieve the thematic goal they had envisioned for their game. The joy, encouragement, and sharing were clearly evident in virtually all the students as they were eager to learn more. Furthermore, students get pride not simply by earning a higher grade, but from involvement with their work and an active desire to participate, using all of these experiences to achieve gratification in their learning processes and in their lives. Many students revealed it was now their plan to learn more about digital technology in the next semester or over the coming years.

The ongoing discussions on creativity, expression, communication, society, personal exploration, and digital media are altogether considered a necessity for life and learning. Individuals living in this modern society need to more fully notice what they face daily, because the facts, ideas, and concepts, as well as their method of delivery serve to provide opportunity for creation and contribution. However, the pivotal element is the human being and his/her individuality—his/her efforts are focused. We educators need to contemplate the best usage of these digital tools for students, instead of squeezing the use of these devices into the curriculum just because many people evoke the use of it.

In brief, the use of digital media affected the students' educational experience in the following ways:

- Students showed high levels of motivation to learn about digital technology; although nervous in the beginning, their commitment, grounded in their pre-existing connection to digital media, led them to learn and apply these new skills to achieve successful outcomes.
- With the desire to be able to make a computer game, students clearly saw the aim of the mission and challenged themselves to learn and construct their own knowledge with the new tools and skills they had begun to master under teacher's instruction.
- Students worked hard while engaging their creativity, whether by topic choice, content research, story planning, art effort, or interactive applications, all in addition to the use of technological techniques.
- Students worked on their projects with a genuine sense of fun and brought joy to their games and the future players.
- Students revealed that pressure was the result of the high standards they placed upon themselves in wanting to achieve the very best for their own projects.
- Students gained pride not simply by earning a higher grade, but from involvement with their work and an active desire to participate, using all of these experiences to achieve gratification in their learning processes.

What Are the Implications for Education in General?

The four teachers who participated in my study all made comments about how the goal of their teaching is not only about teaching students to use technologies, make video games, or create their own meaningful interactive projects. Also, they want to assist students to be efficient as they live and work in the new age. Bers (2010) contended that the aim of technological development is to guide students in the positive use of technology, so they can have more fulfilling lives for their future work or achieve innovative thinking to make the world a better place. Ms. Moore, Ms. Wood, and Mr. Winter all said they want to prepare their students with the skills they will probably use in the next decade, even if they cannot guess what kind of life their students will have or environment in which they will be living. Mr. Winter brings diverse projects to his teaching to engage his students in varying forms of presentation. Mr. Snow also points to learning about logical thinking and problem solving as key goals. As mentioned above, using successive reasoning for a standpoint signifies logical thinking. In the digital environment with all kinds of possible choices of devices, programs, or websites, students who acquire the skill of logical thinking will enhance their ability to make a more sophisticated choice for the tasks and challenges they face. It is an attitude that students have and will develop while working in the digital environment. Similar to learning to solve problems, the learner grasps a certain concept, fact, or procedure, then makes a decision towards attaining a better conclusion. Ms. Wood reflected on her intention to teach her students to become lifelong learners, ensuring that they are capable of searching for answers, even if there is no instructor. In actuality, young learners who involve themselves with various technologies in such an informal setting can be very creative and competent, while approaching a diverse range of formal and informal modes of learning strategy (Ch. 2, p. 63). In essence, this means learning to be confident individuals, living in a technology-rich world. Such individuals will know how to ask for help from their teachers and the tools in front of them, and access all possible information to create novel ideas for life tomorrow.

The production of digital media has influenced students' behavior and educators' attitudes towards formal and informal learning, all while digital media and technologies have become irresistible and ubiquitous in our lives. The attitude of learning how to learn, application of new knowledge, critical reasoning, and information contribution together constitute a positive outcome of lifelong learning, which individuals are experiencing with the implementation of these technologies. Getting on-line to gather information, making sounds with their skills in GarageBand, or recording a movie on iMovie are not intrinsically critical components of learning for these students who told me about their experiences with digital media. However, once they know the objective of their projects, they bring these experiences and learning into their lives with challenge, effort, and joy, and often apply these skills in new and unanticipated ways. For many students, their learning experience comes from applying their research and observations to living. This is the form of constructionism that Kafai and Resnick (1996) emphasized: Educational reform should be selective in the ways educators are conscious of students' interactions toward the development of their own distinctive learning approaches. Knowledge is constructed in the context of building a personally meaningful connection to effort, task, and result.

Digital media, as a new form of presentation, employs the exploration of learning concepts—collective knowledge as individuals search and gather information on the web and from experience. One of these new modes of expression and learning is expressed by the making of video games, which I examined in this study. In the course of discussing lifelong learning, the understanding of digital citizenship is also a substantial lesson. Digital citizenship commonly refers to a person who participates in society, politics, and the world via digital media. Examples include shopping on-line, using social networks, creating blogs, and interacting with web-based journalism sites. In a brief discussion in Chapter 2, Mossberger et al. (2008) stated that the initiation of digital media, along with the creation of the Internet, advances a human being's aptitude in communication and information searching. It is a new model for society.

Students in the four classes observed for this study expressed their fondness for searching for information on the web, watching videos on YouTube, and, of course, playing video games on their favorite websites. Because students were making games through the utility of Scratch, they all had reviewed games on the Scratch website. This connection to digital media was seen in how several students also shared with me their use of Facebook to connect with friends. And although this next observation is important as a footnote to their use of the Internet, there is no doubt that students today spend more time on the Internet than watching TV. A recent survey revealed that 95% of American teenagers, ages 12-17, are regularly online (Lenhart et al., 2011). On his school website, Mr. Snow wrote, "Students understand human, cultural, and social issues related to technology and practice legal and ethical behavior under the category of digital citizenship." During our conversations, Ms. Moore and Ms. Wood also emphasized learning to be a digital citizen; and within this concept, the proper attitude to respond to and share opinions with peers in person or on the web is often a first lesson for students. Ms. Wood also pointed out the protocols for selecting the log-in name chosen for on-line activities, because within the practices of digital media, users must consider issues of personal and social identity, the complexity between private and public personas, and ethical and legal concerns. The environment of authors and audiences, messages and reality, and meaning and metaphor can intensify students' learning in critical thinking, problem solving, and communication skills. This all combines to underscore the importance of the ways in which students approach the digital media environment and how critical it then is that they see it as a safe way to communicate and connect with others. Moreover, the digital media environment provides opportunities for students to make a better world through the use of their computational skills and the use of these new ways of thinking.

Digital citizenship and new media literacy emphasize the skills and knowledge needed to be effective in the increasingly digital media environment (Hobbs & Jensen, 2009). In Chapter 2, I discussed how new literacy extends the symbolic manipulation of the skills of traditional print media by integrating video, because it creates a means for creative and social expression, and communicating by integrating video, images, music, or animation in the digital environment (Ch. 2, p. 57). Digital media supports the existing forms of communication to interact with peers and both interested and interesting external groups. Indeed, these digital technologies allow individuals to pursue their own interests and areas of attention. Yet, new technologies consist of not only the tools of practice, but also the context of local and global interaction with personal involvement that is central to new literacy (Curwood & Gibbons, 2010; Lewis, 2007). New literacy is becoming more personal and the supporting equipment provides individuals more opportunities for freedom in their personal lives, as they strive for fulfillment in all areas of personal, professional, and scholastic endeavor, connecting with society or even the entire world. Following the knowledge revolution, individuals are now experiencing new knowledge created with new literacy as today's reality—one that educators need to learn from—as both people and these technologies interact with society and its changes. With the argument I raised throughout the study, the challenge is in how educators address these changes and mold their evolution to help people think about the digital media they encounter as participants in a digital society (Ch. 2, p. 62). The four teachers in this study have chosen to embark on education in the digital era and encourage their students to participate in the use of digital tools to thrive in modern life.

Many teachers have spoken about how technologies stimulate students to work on their homework. Mr. Snow reflected that students like to search on the Internet, with interests ranging from their favorite singers to a pair of tennis shoes. Students' attitudes while playing games on-line or interacting with people for conversation are very different, and there are a number of educators who now consider and incorporate these attitudes into their curriculum. Motivated teachers use supportive tools to stimulate students to learn the knowledge necessary to move forward in school and in their lives. However, in some cases, the gap between teachers' perspective and students' response has caused misunderstanding. Hobbs and Jensen (2009) remarked that educators must find creative ways to change educational practice and work to increase the knowledge and skills of students. Learning should shift the focus away from tools alone to actual competence. For example, knowledge of Microsoft Office is mandatory to allow individuals to produce a creative and organized presentation. But, the teachers' focus should be to inspire students towards using all the tools at their disposal, including their imagination, to deeper exploration for a meaningful final project. That is more important than teaching them the list of tools in the programs. A project, such as the game-making based learning project provided in these four teachers' digital technology classes, causes educators to undertake a deeper examination, when thinking about the message that is being created for and received by students.

Ms. Moore pointed out that freedom is what students liked in her digital technology class. It is the freedom that motivates her students to examine the knowledge they want to learn, and not merely master a task as if by rote. Further, the creative mind is inspired and practiced while students engage with learning by personal choice. So, while students are ready to explore their capabilities in the digital environment, educators must retain an open attitude to allow students to express their identity, reflect on their lives, and share their experiences as they live and learn. In this study, the four teachers showed their concern in teaching digital media technology. They constantly challenged themselves to select useful instructions for their students and challenge them to learn with all the educational assets available in the digital era.

In Chapter 1, I raised the concept of awareness of the "digital kid" in the 21st century. I agree with Taylor and Carpenter (2007) that students expect that they can connect with their friends, retrieve information, or get responses from their teachers instantaneously. Ms. Moore disclosed that patience with the process of learning is a lesson that her students learned while learning to make games in her class, because she believes it is a great lesson to understand that some goals are not always easily reached.

Ultimately, students in the digital age act, think, and learn differently (Taylor & Carpenter, 2007). Many students I approached for this study agreed they are attached to the notion of working on their laptop, using a mobile phone or iPod, and generally being very fluent with these technologies. Some students also shared with me that their favorite form of entertainment is to watch funny videos or listen to music on YouTube, and they prefer to text rather than talking on the phone. These students find their pleasure with images and symbols on the screens of their favorite devices. They develop networked selves that adapt to their digital environment. I am amazed how these devices shape their lifestyle and how they witness and embrace their potential in digital society. Regarding the significance of the digital experience, Taylor and Carpenter (2007) explained that digital metaphors rely upon historical references and concomitantly challenge and change in the process. In Chapter 2, I discussed the perception of re-thinking the approach to digital media in the 21st century, and that the way we communicate and retrieve information is different as compared to even a short decade ago. In light of their constantly changing digital landscape, students today demand different forms of engagement in life, play, or learning. The students I approached for this study clearly showed their adeptness with digital media.

What are the theoretical and practical implications for the inclusion of digital media in education? Whereas life in a digital world might be well-suited for these students, many of their teachers have not yet fully connected to these forms of life and learning with respect to teaching and learning. There is a large number of schools who include the use of digital technologies for teaching and learning, but there are only a small number of teachers who use these tools effectively as forms of instruction for their students and in ways that will both connect them with knowledge and enhance the knowledge they have already gained (Ch. 2, pp. 70-72). In this study, Ms. Wood's school is noted for its outstanding technology program, and Mr. Winter and Mr. Snow's school is also a technology-emphasized school. All four teachers believe that digital technology does influence thinking, social relationships, communication, and knowledge cognition, with a concrete learning experience achieved through a digital approach. The game-making based learning project these four teachers offered to their classes is based on discovery rather than delivery of information. Many researchers have determined that the reward of learning is by doing versus being told, and deep learning is attained while students interact with a playful learning experience and practice.

There is no doubt, today's students have grown up with digital media, and this exposure has shaped the way they advance toward learning. Students playing video games is not an extraordinary event; it is but one example of how today's learners are truly digital natives. Many educators have accordingly adopted the context of interactivity and engagement with games in learning procedures. Currently, making games for learning has become a popular form of teaching in contemporary education. Its broader use in disciplines for creative mind-in-action approaches to problem solving or awareness raising is seen as important when educating the students of today, because digital media and game-making based learning are so very much a part of their lives.

Beyond that, students also practice their own planning, thinking, researching, communicating, and commitment to hard work. Learners are not just observers or consumers, but also producers and active participants in game-making based learning. The goal is for students to learn to express themselves fluently in a conversation with modern society. Students learn a new attitude of self-motivated, continuing education to keep learning a new platform, new modalities, and new techniques. They create meaningful projects that reflect their knowledge of understanding academic content, as they continue to develop digital fluency and literacy. As discussed in this study, a digital media program, such as game-making based learning, provides students with a combination of the theoretical, aesthetic, and technical knowledge necessary for success as digital media developers, creators, researchers, and evaluators in a rapidly changing environment. Students learn skills in communication, instruction, research, creative production, and problem solving, and will be able to analyze and evaluate the functional and communication aspects of digital media design and production. While these students I approached in this study were eager to share their projects with peers, teachers, and their families, their confidence revealed their deep affection to and reflection on learning. Speaking about digital technology, Bers (2010) contended that although students learn better when exploring (computational) materials and developing their own (computational) theories, the main theme is that digital technology can serve as epistemological tools when students are given the opportunity and the tools to make their own projects, thus creating their own content by learning how to program.

Kafai and Resnick (1996) remarked that learners actively connect with learning and engage with knowledge while approaching personal and meaningful projects. In this study, students had the freedom to choose the topic for their project, following their teacher's guidance. For example, Jennifer chose to use owls and cookies as her main characters because of her affection for owls. Sam used knowledge learned in chemistry class for his project. Students construct their own learning cognition while significantly connecting their individual attachment to people, place, and things to their studies. Following Piaget and Inhelder, constructionism might best be imparted here as construction of knowledge in the context of establishing personal experience with the development of digital tools, new literacy, and digital experiences in a playful way (as referred to in Ackermann, 1996). Dewey (1916) also stated, "Education is not an affair of 'telling' and being told, but an active constructive process" (p. 38). Game-making based learning offers the opportunity for learners to engage with learning by doing, as they experience learning in an authentic learning activity.

Although I did not address the issues of caring and compassion for, from, and amongst all persons, individuals are seen as generally willing to use technologies to respond to the needs of others. For example, the new ways of communication through social media, such as Facebook, e-mail, and texting, serve as a larger community of personal resources—a community of help. Most social media tools encourage communication, collaboration, and community building. This form of content creation and creativity is then seen as a new digital village, with corresponding interdependencies that are best achieved where the "villagers" are comfortable with all the tools that are seamlessly integrated into their lives.

Digital media and technologies are changing the developmental landscape for young learners in the digital age of today and the future. The task for educators is to review and design innovative educational approaches supporting students in their good use of digital media and technology. In actuality, it is not an idea for more consideration but a necessity of paramount and urgent importance. Moreover, the framework that guides our educators' beliefs and actions is important, because this framework will guide the style of the programs of digital media that are implemented, as well as the new kinds of learning cultures that will emerge from their realization. We, as educators, need to continue to help students become active participants as well as authors of their own identity and creativity. The act of learning, along with digital citizenship and new literacy, should develop informed, reflective, and engaged members of society, essential to becoming a modern citizen. These issues are central to the experience of growing up in a world full of mass media, personal recognition, diverse cultures, and digital media.

Overall, the implications of this new pedagogy for education in general are as follows:

- The production of digital media has influenced students' behavior and educators' attitudes towards formal and informal learning, all while digital media and technologies have become irresistible and ubiquitous in our lives and support the existing forms of communication.
- Digital citizenship is a substantial lesson in the course of discussing digital learning and the understanding of the digital framework of society.
- The use of new literacy assists individuals with more opportunities to strive for fulfillment in all areas of personal, professional, and scholastic endeavor, connecting with society or even the entire world.
- The reward of learning is by doing versus being told, and deeper learning is attained while students interact with their own planning, thinking, researching, communicating, and commitment to hard work.
- A digital media program, such as game-making based learning, provides students skills in the communication, theoretical, aesthetic, creativity, and technical knowledge necessary for success as digital media developers, creators, researchers, and evaluators to express themselves fluently in a conversation with modern society.

- The task for educators is to constantly challenge themselves to review and design innovative educational approaches and support students towards using the tools at their disposal, including their imagination, to deeper exploration in meaningful, concrete learning experience.
- Educators need to continue helping students become active participants as well as authors of their own identity and creativity. The act of learning, along with new literacy, should develop informed, reflective, and engaged members of society, essential to becoming a modern citizen.

Conclusion

This study addressed teachers' intentions for teaching a digital media program and students' development in the field, along with the impact of game-making based learning. In 1934, Dewey stated that students learn more effectively when their action of learning offers the opportunity to try out what they have learned with their own unique skills. Papert (1980), a MIT professor and educational expert, declared that learners become deeply engaged by fun while "doing," because the reward of fun motivates deeper engagement. Many students' best learning experiences come when they have become attached to the subject through interaction. Digital media and technology-integrated learning offer the opportunity for learners to engage with learning by doing, while experiencing learning in an authentic and interactive learning activity.

Students under the instruction of the four teachers in the study accomplished their projects with a program called Scratch. Scratch is a computer program developed by the educational experts at MIT and offers users the chance to make a computer game while learning a very basic programming concept and language. The program uses blocks of instructional code to provide users choices for action, and the users can simply create a game by dragging blocks into a given order, resulting in an animation. Users can then share their work, comments, tips, and discussions on several websites via the Internet. Currently, making games for learning has become a popular form of teaching in contemporary education. There are many companies and institutions of higher learning involved in this field. The aim is to provide the users disciplines for creative mind-in-action approaches to problem solving and awareness raising, both of which are important when discussing education in modern society. During my observations, students showed high interest in their digital game projects, as well as integrated learning achieved with these technologies. Students were eager to learn to make their own games and expressed their enthusiasm for learning. In this regard, it is valuable to lead students to approach these diverse programs and expand their viewpoints from one subject, one animation, one interaction, and one game-making program to various choices and lessons in the digital world.

Learning in the digital age is not solely about using any specific software package or a cloud computer service. There are a large number of schools that include the use of digital technologies for teaching and learning, yet only a small number of teachers who choose to learn and use these tools effectively as instruction for the students of today.

The four teachers involved with this study hold positive opinions of the digital world and believe in the use of diverse new tools and concepts in teaching. Digital media and technologies are changing the developmental landscape for young learners in the digital age of today and for the future. The task for educators is to review and design innovative educational approaches supporting students in good uses of digital media and technology. In actuality, it is not an idea for more consideration but a necessity of paramount and urgent importance. Meanwhile, the structure that escorts our educators' beliefs and actions is important, because their beliefs and actions will guide how the programs of digital media are implemented within their realization of teaching and learning in modern education. These four teachers bring their passion to help students engage with the digital era and further their personal commitment to modern education. They believe teachers can learn to work together with their students. This is an attitude educators should embrace in the 21st century. Educators can learn together with the students and explore the originality that can be achieved in the digital era. Further, they can help students become active participants as well as authors of their own identity and creativity.

Digital media technologies and game-making based learning are essential to keep students attracted to the subject they are learning. The challenge for making a game is not only about dealing with new software, but also about how the makers combine together all learned skills and make the game work. Since the beginning, when students first experienced these new programs, they began to visualize both the whole and individual components of the required work, and processed the questions and challenges they encountered towards the completion of their game. It was not only the motivation students had for making a game; they were also engaged to understand sequence, logic, rules, and concepts of the game that determined how things had to happen for it to function properly.

The teachers' relationship with their students is pivotal to keeping students engaged in the process of learning. During my observation, these teachers always walked around the class to discuss with individual students or a small group about their work process, offering discussions about what they were learning and how it might be applied to other lessons. These interactions were ways students were encouraged to express their thoughts and keep connected to their work. The teachers kept communicating, trying to inspire students to think of applications for the information they gained in these activities, and carried on conversations inspiring students to think about their work in new contexts. Students are attracted to work on a personal question or subject meaningful to them. For many students, their creativity comes from their attention to living. This is a form of constructionism emphasizing students' interaction with the development of their own distinctive learning approach. Knowledge is constructed in the context of building a meaningful connection to effort, task, and result.

When students completed their projects and shared them with their friends in class or wanted to bring them home to show their family members, they exhibited gratification and satisfaction in their work and completion of their project, as they presented their final work product. Engagement was seen in the students' enjoyment and their newfound pride in their aptitude to the task. When I viewed students' striving hard at their work and their eagerness to share their work with others, it was clear it was because they enjoyed what they were doing.

Living in the digital age, the way we, as educators, consider the new process of educating is changing. It is not only about *what* we teach but *how* we teach. Even *what* and *how* we learn is changing. Learning with digital media, like game-making based learning, is not about giving instructions for using the tools, but about exploring radically new approaches to instruction. The learning is not determined by the tools but by the educators' re-thinking of the relationships between the teachers, students, tools, concepts, and attitudes, and how to integrate these tools and concepts in learning for inspiration. There are still many issues requiring attention in digital media-integrated learning. Generally, these issues are central to the experience of growing up in a world full of mass media and the need for personal recognition, embracing diverse and new cultures of life and learning yet to be seen through the eyes and ears of digital media. Being educators in the digital age, with a global view, we need to contemplate the best usage of these and other techniques, and provide our students every advantage towards reaching an informed international perspective.

Closing Comments

As I mentioned above, we, as educators, need to consider education as fitting with contemporary life. The contemplation of *how* we teach and learn is important as well as *what* we teach and learn. As emphasized above, learning with digital media is not about merely giving instructions for using these tools but about exploring radically new approaches to instruction. Learning is not determined by tools but by the re-organization of the power relationships in school and institutional protocols. Educational experts making decisions about the future of education need to consider planning today for education tomorrow to keep pace with the rapid change of society. Whereas there are countless issues we, as educators, may not be able to immediately acknowledge, it is time to start planning the potential techniques to meet the needs in such a digital society.

Further Research

This study provides a detailed understanding of existing practice in four separate digital technology classes in middle schools in suburban Denver, Colorado, and supplemental thoughts in the field of digital media in education. I hope I have imparted observations from the field that warrant inclusion in contemporary and future educational protocols. Additionally, several points of consideration for further research have been perceived during the current study, strongly suggesting that continued work is needed from many perspectives.

During my observations in Mr. Winter's class, the learning disability students' approach and reaction to digital media and technology use or learning caught my focused attention. Lately, many scholars have addressed the potential of using computers or iPad-like devices to assist learning for this demographic. I would be interested to look at this impact and learn how to develop a sequential curriculum for the learning disabled.

I have also mentioned my observations on gender in approaching the field of digital media and how this might warrant further study to refine our approaches. Again, several scholars have studied this subject from the perspective of how girls approach digital media technology to that of how to actually *help* and *encourage* girls to approach digital media technology. A further question would be, Do boys and girls have different levels of acceptance while developing computing thinking and regarding how to work together—collaborate with their peers? The very notion of "computing thinking" implies that the tasks of learning and life are changed in the context of the computer, and the overlay of gender, age, race, ethnicity, and more merit exploration.

There is actually a gap in the digital media and technology programs between elementary school, middle school, and high school, and from one district to another. It is one point of evidence of the possible conflict or inconsistency in the viewpoints of educational leaders, administrators, principals, and teachers. How necessary is it to develop a consistent and well-aimed curriculum for K thru 12 schools with digital media?

Learning is taking place in informal learning practice through Internet use. This practice extends learning beyond institutional boundaries. Do students still only need a formal curriculum for learning with digital media in today's schools? How can open-source tools be used to create situations where learners actively engage and become more proficient, think more in more detailed and complex ways, gain better rational viewpoints, and lead distinctive and productive lives? Open-source tools may be one solution to the budget constraints of today's classroom environments and yet another way we see the digital age support new techniques in modern education.

Whereas this study examined four teachers who specifically teach a digital technology class and have 5 to 10 years of experience in the field teaching, I would also like to learn about the perspectives of teachers in the use of digital media and technology who are not technology teachers and how they incorporate these tools into their teaching. For example, regarding the math or language arts teachers in Ms. Wood's school who always checked out laptop carts for their classroom teaching, how do they utilize these technologies?

Finally, in discussing learning in the digital age, both teachers and students need to become digital citizens and to be responsible for their behavior on the web. I strongly believe a proper attitude is essential for students whenever they interact with others in the digital environment. I have considered studying the issues of digital citizenship, new literacy and their impact on lives in and out of the digital context.

The topic of using digital media in education will continuously be discussed, if for no other reason than the continuous evolution of the tools. Indeed, we already participate with digital media in life. Learning can be a connection between current interest and the technological habits of our students, and digital media can hold a positive role in the process of transforming education from lecture-and-receive—or even rote—forms of learning to an interactive and student-guided form of living with these technologies.

REFERENCES

About Google Scholar. (2011). Google Scholar website. Retrieved from http://scholar.google.com/intl/en/scholar/about.html

About Scratch (2011). Scratch documentation site. Retrieved from http://info.scratch.mit.edu/About_Scratch

Abrami, P. C. (2001). Understanding and promoting complex learning using technology. *Educational Research and Evaluation*, *7,* 113-136.

Ackerman, E. (1995). Construction and transference of meaning through form. In L. Steffe & J. Gale (Eds.), *Constructivism in education* (pp. 341-354). Mahwah, NJ: Erlbaum.

Ackermann E. (1996). Perspective-taking and object construction: Two key's to learning. In Yasmin, K. & Mitchel, R. (Eds.), *Constructionism in practice: Designing, thinking, and learning in a digital world* (pp.25-35). Mahwah, NJ: Lawrence Erlbaum Associates.

Akhter, S. (2003). Digital divide and purchase intention: Why demographic psychology matters. *Journal of Economic Psychology*, *24,* 231-327.

Albrecht, K. (1984). *Brain building: Easy games to develop your problem-solving skills*. Upper Saddle River, NJ: Prentice-Hall.

Aleman, A., & Wartman, K. (2009). *Online social networking on campus*. New York, NY: Rouledge.

Allen, J. D. (1986). Classroom management: Students' perspectives, goals, and strategies. *American Educational Research Journal*, *23*(3), 437-459.

Amabile, T. M. (1983). *The social psychology of creativity*. New York, NY: Springer-Verlag.

Amabile, T. M. (1988). A model of creativity and innovation in organizations. In B. M. Staw & L. L. Cummings (Eds.), *Research in Organizational Behavior*, *10,* 123-167.

Amabile, T. M. (1995). *KEYS: Assessing the climate for creativity*. Instrument published by the Center for Creative Leadership, Greensboro, NC.

Amabile, T. M. (1996). *Creativity in context: Update to "The social psychology of creativity."* Boulder, CO: Westview Press.

Ayiti: The Cost of Life (2012). Designed by Global Kids Paying 4 Keeps [youth media project]. Funded by Microsoft. Retrieved from http://ayiti.globalkids.org/game/

Babies born from 2010 to form generation alpha. (2009, November 15). *The Sunday Telegraph.* Retrieved from news.com.au website http://www.news.com.au/features/babies-born-from-2012-to-form-generation-alpha/story-e6frfl49-1225797766713

Baek, Y., Kim, B., Yun, S., & Cheong, D. (2008). Effects of two types of Sudoku puzzles on students' logical thinking. In T. Connolly & M. Stanfield (Eds.), *Proceedings of the Second European Conference on Game Based Learning* (pp. 19-24).

Baer, J., & Kaufman, J. C. (2005). Bridging generality and specificity: The amusement park theoretical (APT) model of creativity. *Roeper Review*, *27*(3), 158-163.

Bai, H., & Ertmer, P. (2008). Teacher educators' beliefs and technology uses as predictors of preservice teachers' beliefs and technology attitudes. *Journal of Technology and Teacher Education*, *16*(1), 93-112.

Baker, E., Gearhart, M., & Herman, J. (1990). The apple classrooms of tomorrow: 1990 UCLA evaluation study. UCLA Center for the Study of Evaluation, Los Angeles, CA.

Bakker, P., & Sadaba, C. (2008). The impact of the internet on users. In L. Kung, R. G. Picard, & R. Towse (Eds.), *The Internet and the mass media* (pp. 86-01). London, United Kingdom: Sage.

Bangert-Drowns, R. L., & Pyke, C. (2001). A taxonomy of student engagement with educational software: An exploration of literate thinking with electronic text. *Journal of Educational Computing Research*, *24*(3), 213-234.

Bangert-Drowns, R. L., & Pyke, C. (2002). Teacher ratings as student engagement with educational software: An exploratory study. *National Research Center on English Learning and Achievement, 50*(2), 23-83.

Barnett, W. (1990). *The idea of higher education*. Buckingham, United Kingdom: Open University Press.

Barry, A. M. S. (1997). *Visual intelligence: Perception, image, and manipulation in visual communication.* Albany: State University of New York Press.

Bass, R. S. (2009). *Even in the face of history: The experiences of gifted African-American students* (Unpublished doctoral dissertation). University of Denver, CO.

Becker, H. J., & Riel, M. M. (2000). *Teacher professional engagement and constructivist-compatible computer use* (Report No. 7). University of California, Irving and University of Minnesota, Centre for Research on Information, Technologies and Organizations.

Beetham, H., & Oliver, M. (2010). The changing practices of knowledge and learning. In R. Sharpe, H. Beetham, & S. de Freitas (Eds.), *Rethinking learning for a digital age: How learners are shaping their own experience* (pp. 155-169). New York, NY: Routledge.

Berger, F., & Ferguson, D. H. (1990). *Innovation: Creativity techniques for hospitality managers.* New York, NY: Wiley.

Bers, M. (2010). Beyond computer literacy: Supporting youth's positive development through technology. *New Directions for Youth Development*, *128*(Winter). doi: 10,1002/yd.371

Bertram, B. (2002). Diversity and critical social engagement: How changing technologies enable new modes of literacy in changing circumstances. In D. Alvermann (Ed.), *Adolescents and literacies in a digital world* (pp. 1-18). New York, NY: Peter Lang.

Bilton, N. (2010). *I live in the future and here is how it works: Why your world, work and brain are being creatively disrupted*. New York, NY: Crown.

Bisson, C., & Luckner, J. (1996). Fun in learning: The pedagogical role of fun in adventure education. *The Journal of Experiential Education*, *19*(2), 108-112.

Black, J. (2006). Displacing student-teacher equilibrium in virtual learning environments. In J. Weiss, J. Nolan, & P. Trifonas (Eds.), *The international handbook of virtual learning environments* (Pt. 2, pp. 497-524). The Netherlands: Springer.

Blumenfeld, P., Soloway, E., Marx, R., Krajcik, J., Guzdial, M., & Palincsar, A. (1991). Motivating project-based learning: Sustaining the doing, supporting the learning. *Educational Psychologist*, *26*, 369-398.

Boczkowski, P. (2005). *Digitizing the news: Innovation in online newspapers*. Cambridge, MA: MIT Press.

Bodrova, E. (2008). Make-believe play versus academic skills: A Vygotskian approach to today's dilemma of early childhood education. *European Early Childhood Educational Research Journal*, *16*(3), 357-369.

Bowers, C. A. (1995). *Educating for an ecologically sustainable culture: Rethinking moral education creativity, intelligence and other modern orthodoxies.* Albany: State University of New York Press.

Bradley, S. P., & Nolan, R. L. (1998). *Sense and respond: Capturing value in the network era*. Boston, MA: Harvard Business School Press.

Brushwood Rose, C. T. (2003). *Technology of experience and potential space: The implications of digital media for theory of learning* (Unpublished doctoral dissertation). York University, Toronto, Canada.

Bryant, T. (2006). Social software in academia. *EDUCAUSE Quarterly Magazine*, *29*(2), 61-64. Retrieved from http://connect.educause.edu/Library/EDUCAUSE+Quarterly/SocialSoftwareinAcademia/39976

Buckingham, D. (2007a). *Beyond technology: Children's learning in the age of digital culture.* Cambridge, United Kingdom: Polity Press.

Buckingham, D. (2007b). Introducing identity. In D. Buckingham (Ed.), *Youth, identity, and digital media* (pp. 1-24). The John D. and Catherine T. MacArthur Foundation Series on Digital Media and Learning. Cambridge, MA: The MIT Press. doi:10.1162

Buckingham, D., & McFarlane, A. (2001). *A digital driven curriculum*? Bergenfield, NJ: Institute for Public Policy Research.

Buckingham, D., & Scanlon, M. (2003). Interactivity and pedagogy in "Edu-tainment" software. *Information Technology, Education and Society*, *4*(2), 107-126.

Bunn K. E. (2009). *Bridging policy and education: How elementary students are impacted by reform efforts* (Unpublished doctoral dissertation).

Cambre, M., & Hawkes, M (2004). *Toys, tools & teachers: The challenges of technology*. Lanham, MD: Scarecrow Education.

Candy, L., & Edmonds, E. (2000). Creativity with emerging technologies. *Communications of the ACM*, *43*(8), 62-65.

Cantoni, L., & Tardini, S. (2008). Communicating in the information society: New tools for new practice. In P. C. Rivoltella (Ed.), *Digital literacy: Tools and methodologies for information society* (pp. 26-44). Hershey, PA: IGI.

Carlton, M., & Winsler, A. (1998). Fostering intrinsic motivation in early childhood classrooms. *Early Childhood Educational Journal*, *25*(3), 159–166.

Carrington, V., & Robinson, M. (2009). *Digital literacies: Social learning and classroom practice*. London, United Kingdom: Sage.

Cashiola, M. (2010, September 21). Game theory. *Memphis Flyer*. Retrieved from http://www.memphisflyer.com/InTheBluff/archives/2010/09/21/game-theory

Castells, M. (1996). *The rise of the Network Society*. West Sussex, United Kingdom: Wiley.

CBS News. (2009, July, 30). New media demands new perspectives. Retrieved from http://www.cbsnews.com/stories/2009/07/21/scitechpcanswer/main5178952.shtml

Chakravarthy, B. (1997). A new strategy framework for coping with turbulence. *Sloan Management Review*, Winter, 69-82.

Chichilnisky, G. (1998). The knowledge revolution. *The Journal of Internal Trade & Economic Development*, *7*(1), 39-54.

Ching, C. C. (1999). *It's not just programming: Reflection and the nature of experience in learning through design*. In C. M. Hoadley & J. Roschelle (Eds.), *Proceedings of the Computer Support for Collaborative Learning (CSCL) 1999 Conference* (pp. 101-107). Palo Alto, CA: Stanford University. Available from Lawrence Erlbaum Associates, Mahwah, NJ.

Cofer, D. (2000). Informal workplace learning (Practice Application Brief No. 10). U.S. Department of Education: Clearinghouse on Adult, Career, and Vocational Education.

Collins, A., & Halverson, R. (2009). *Rethinking education in the age of technology: The digital revolution and schooling in America.* New York, NY: Teachers College Press.

Confrey, J. (1994). A theory of intellectual development. *For the Learning of Mathematics*, *14*(3), 2-8.

Corbett, S. (2010). Learning by playing: Video games in the classroom. *The New York Times*, Education Section, pp. 54-61.

Cordes, C., & Miller, E. (2000). *Fool's gold: A critical look at computers in childhood*. College Park, MD: Alliance for Childhood.

Corsaro, W. (1997). *The sociology of childhood*. Thousand Oaks, CA: Pine Forge.

Cowan, R. S. (1997). *A social history of American technology*. New York, NY: Oxford University Press.

Craft, A. (2000). *Creativity across the primary curriculum: Framing and developing practice*. London, United Kingdom: Routledge/Falmer.

Creanor L., & Trinder, K. (2010). Managing study and life with technology. In R. Sharpe, H. Beetham, & S. de Freitas (Eds.), *Rethinking learning for a digital age: How learners are shaping their own experiences* (pp. 43-56). New York, NY: Routledge.

Creswell, J. W. (1998). *Qualitative inquiry & research design: Choosing among five approaches* (2nd ed.). Thousand Oaks, CA: Sage.

CTIA - The Wireless Association. (2010). 50 wireless quick facts. *CTIA consumer information*. Retrieved from http://www.ctia.org/consumer_info/service/indes.cfm/AID/10323

Cuban, L. (2001). *Oversold and underused: Computers in the classroom*. Cambridge, MA: Harvard University Press.

Cukier, K. N. (2007). The Internet, regulation, the private sector and public safety. *International Journal of Communication*, *1*, 162-169.

Cullinane, M., & Hess, F. M. (2010). *What next? Educational innovation and Philadelphia's school of the future*. Cambridge, MA: Harvard Education Press.

Cunningham, G. (2010). Bookless in Seattle (Recently in *Issues in Higher Ed* category). *Technology enhanced learning at the University of Minnesota*. Retrieved from http://blog.lib.umn.edu/tel/blog/online-education/issues-in-higher-ed/

Curwood, J. S., & Gibbons, D. (2010). "Just like I have felt": Multimodal counternarratives in youth-produced digital media. *International Journal of Learning and Media*, *1*(4), 59-77. Retrieved from http://www.jensc.org/wp-content/uploads/2010/09/Curwood-and-Gibbons-Just-Like-I-Have-Felt.pdf

Cuthbert, A., & Hoadley, C. (1998). *Designing desert houses in the knowledge integration environment.* Paper presented at the annual meeting of the American Educational Research Association, San Diego, CA.

Czubaj, C. A. (2004). Literature review: Reported educator concerns regarding cyberspace curricula. *Computer & Education, 124*(4), 676–683.

Daily News. (2006, December 15). Yahoo News & ABC News expand video content agreement [Press release]. Retrieved from http://www.designtaxi.com/news/6252/Yahoo-News-ABC-News-Expand-Video-Content-Agreement/

Davidson, C. N., & Goldberg, D. T. (2010). *The future of thinking: Learning institutions in a digital age*. Cambridge, MA: MIT Press.

Davis, G. A., & Tu, T. (2008). Mathematics and science in the early years: International perspectives and theoretical views. In P.G. Grotewell & Y. R. Burton (Eds.), *Early childhood education: Issue and developments* (pp. 23-45). New York, NY: Nova Science.

De Freitas, S., & Conole, G. (2010). Learners experiences: How pervasive and integrative tools influence expectations of study. In R. Sharpe, H. Beetham, & S. de Freitas (Eds.), *Rethinking learning for the digital age: How learners shape their own experiences* (pp. 15-33). New York, NY: Routledge.

Deci, E., & Ryan, R. (1985). *Intrinsic motivation and self-determination in human behavior*. New York, NY: Plenum Press.

Delacruz, M. (2009). Art education aims in the age of new media: Moving toward global civil society. *The Journal of the National Art Education Association*, *62*(5), 13-18.

Delpit, L. (1995). *Other people's children: Cultural conflict in the classroom*. New York, NY: The New Press

Deuze, M. (2007). *Media work: Digital media and society*. Cambridge, United Kingdom: Polity Press.

Dewey, J. (1916). *Democracy and education: An introduction to the philosophy of education.* Norwood, MA: Macmillam.

Dewey, J. (1934). *Art as experiences*. New York, NY: Capricorn Books.

Dewey J. (1938). *Experience and education*. New York, NY: Kappa Deita Pi.

DiMaggio, P., Hargittai, E., Neuman, W., & Robinson, J. (2001). Social implications of the Internet. *Annual Review of Sociology*, *27*, 307-336.

Dirckinck-Holmfeld, L., & Ryberg, T. (2010). Analysing digital literacy in action: A case study of a problem-oriented learning process. In H. Beetham & R. Sharpe (Eds.), *Rethinking pedagogy for a digital age: Designing and delivering e-learning* (pp. 170-183). New York, NY: Routledge.

Driori, G., & Jang, Y. S. (2003). The global digital divide: A sociological assessment of trends and causes. *Social Sciences Computer Review*, *21*(2), 144-161.

Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychology Rev*iew, *95*(2), 256-273.

Education 2020. (2011). Scratch: Programming for everyone. Retrieved from http://education-2020.wikispaces.com/Scratch+Animation

Education in action: Learning today…leading tomorrow: *Hearing before the House Committee on Science Space and Technology,* 112th Cong. (2011) (testimony of A. Attard).

EduTech. (2011). Scratch for education. Retrieved from http://edutech.csun.edu/eduwiki/index.php/Scratch_for_Education

Eisner, E. W. (1991). *The enlightened eye: Qualitative inquiry and the enhancement of educational practice*. New York, NY: Macmillan.

Eisner, E. W. (1998). *The enlightened eye: Qualitative inquiry and the enhancement of educational practice.* Upper Saddle River, NJ: Merrill Prentice Hall.

Eisner, E. W. (2002). *The educational imagination: On the design and evaluation of school programs* (3rd ed.). Upper Saddle River, NJ: Merrill Prentice Hall.

Elliott, E. S., & Dweck, C. S. (1988). Goals: An approach to motivation and achievement. *Journal of Personality and Social Psychology*, *54*(1), 5-12.

Ellis, R., & Goodyear, P. (2010). *Students' experiences of e-learning in higher education: The ecology of sustainable innovation*. New York: Routledge.

E-mail. (2010, September 14). *The Titi Tudorancea Bulletin*. Retrieved from http://www.tititudorancea.com/z/e_mail.htm

Ereaut, G. (2007). *What is qualitative research*? QSR International Ltd. Retrieved from http://www.qsrinternational.com/what-is-qualitative-research.aspx

Facebook. (2010). *Facebook statistics*. Retrieved from http://www.facebook.com/press/info.php?statistics

Faux, S. A., Walsh, M., & Deatrick, J. A. (1988). Intensive interviewing with children and adolescents. *Western Journal of Nursing Research*, *10,* 180–194.

Feldman, A. (2000, November). *Existential approaches to action research*. An invited paper at the Annual Symposium of the National Academy of Educational Researchers, Ponte Verde, FL.

Field, J. (2006). *Lifelong learning and the new educational order*. Staffordshire, United Kingdom: Trentham Books.

Finger, G., & Lee, M. (2010). *Developing a networked school community: A guide to realizing the vision.* Victoria, Australia: ACER Press.

Finn, J. D. (1989). Withdrawing from school. *Review of Educational Research, 59*, 117-142.

Fischer, H. (2006). *Digital shock: Confronting the new reality*. Quebec, Canada: McGill-Queen's University Press.

Fisher, E. (2010). *Media and new capitalism in the digital age: The spirit of networks*. New York, NY: Palgrave Macmillan.

Food Force: The first humanitarian video game. (2012). Sponsored by the World Food Programme. Retrieved from http://www.wfp.org/how-to-help/individuals/food-force

Fuchs, C. (2008). *Internet and society: Social theory in the information age*. New York, NY: Routledge.

GarageBand'11. (2012). What is GarageBand. Retrieved from http://www.apple.com/ilife/garageband/what-is.html

Garris, R., Ahlers, R., & Driskell E. (2008). Games, motivation and learning: A research and practice model. *Simulation & Gaming*, *33*(4), 441-467. doi:10.1177/1046878102238607. Retrieved from http://www.hci.iastate.edu/REU09/pub/Main/BiologyInVRBlog/games_motiviation_learning.pdf

Garvey, C. (1990). *Play: The developing children*. Cambridge, MA: Harvard University Press.

Gee, J. P. (1990). *Social linguistics and literacies: Ideology in discourses, critical perspectives on literacy and education*. London, United Kingdom: Falmer Press.

Gee, J. P. (2003). *What video games have to teach us about learning and literacy.* New York, NY: Palgrave Macmillan.

Gee, J. P. (2005). *Why video games are good for your soul: Pleasure and learning*. Melbourne, Australia: Common Ground.

Gee, J. P. (2008). *Getting over the slump: Innovation strategies to promote children's learning*. New York, NY: The Joan Ganz Cooney Center. Retrieved from http://www.joanganzcooneycenter.org/upload_kits/1_1.pdf

Geertz, C. (1973). *The interpretation of cultures*. New York, NY: Basic Books.

Ginger, J. (2008). *Social computing phenomena* (The Facebook Project). facebook.com. Retrieved from http://www.thefacebookproject.com

Glaserfeld, E. V. (1983). Learning as constructive activity. In J. C. Bergeron & N. Herscovics (Eds.), *Proceedings of the 5th Annual Meeting of the North American Group of Psychology in Mathematics Education*, *1,* 41–101, Montreal: PME-NA.

Gleick, J. (2011). *The information: A history, a theory, a flood*. New York, NY: Pantheonbooks.

Glesne, C. (1998). *Becoming qualitative researchers: An introduction* (2nd ed.). Boston, MA: Pearson Education.

Google Docs. (2012). Google Docs website. Retrieved from http://www.google.com/google-d-s/documents/#__utma=72592003.573091327.1348086715.1348086715.1348086715.1&__utmb=72592003.2.10.1348086715&__utmc=72592003&__utmx=-&__utmz=72592003.1348086715.1.1.utmcsr=(direct)|utmccn=(direct)|utmcmd=(none)&__utmv=-&__utmk=98204441

Google Maps. (2012). Google Maps website. Retrieved from http://maps.google.com/

Gorman, J. (2009). *Benefits of computer education*. Thomas Jefferson High School for Science and Technology, Alexandria, VA. Retrieved from http://www.tjhsst.edu/~rlatimer/techlab09/GormanPosterWhiteQ4-09.pdf

Gray, L., Thomas, N., & Lewis, L. (2010). *Educational technology in U.S. public schools: Fall 2008*. Washington, DC: U.S. Department of Education, National Center for Education Statistics.

Greene, B. (2000). *Teachers' tools for the 21st century: A report on teachers' use of technology*. Washington, DC: U.S. Department of Education, Office of Educational Research and Development.

Greenfoot: Teach & Learn Java Programming. (2012). A project in the Programming Education Tools Group, part of the Computing Education Research Group at the

School of Computing, University of Kent in Canterbury, United Kingdom. Retrieved from http://www.greenfoot.org/overview

Hall, R., & Stevens, R. (1995). Making space: A comparison of mathematical work in school and professional design practices. In S. L. Starr (Ed.), *The cultures of computing* (pp. 118-145). Cambridge, MA: Blackwell.

Harding, D., & Ingraham, B. (2007). The art of design. In H. Beetham & R. Sharpe (Eds.), *Rethinking pedagogy for a digital age: Designing and delivering e-learning* (pp. 142-152). New York, NY: Routledge.

Harel, I. (1991). *Children designers*. Norwood, NJ: Ablex.

Hatch, J. A. (2002). *Doing qualitative research in education settings*. Albany: State University of New York Press.

Hatch, J. A., & Barclay-McLaughlin, G. (2006). Qualitative research: Paradigms and possibilities. In B. Spodek & O. Saracho (Eds.), *Handbook of research on the education of young children* (pp. 497-514). Mahwah, NJ: Erlbaum.

Henten, A., & Tadayoni, R. (2008). The impact of the Internet on media technology, platforms and innovation. In L. Kung, R. G. Picard, & R. Towse (Eds.), *The Internet and the mass media* (pp. 45-64). London, United Kingdom: Sage.

Hobbs, R., & Jensen, A. (2009). The past, present, and future of media literacy education. *The Journal of Media Literacy Education*, *1*(1), 1-11.

Holm Sorenson, B. (2005). *Informal learning - Power users of information and communication technology*. Paper presented at the Power Users of Information and Communication Technology International Symposium, San Juan, Costa Rica: EDC.

Holm Sorenson, B., Jessen, C., & Olsen, B. R. (2007). Children's informal learning in the context of schools of the knowledge society. *Education and Information Technology*, *12*(1), 17-27.

iCODE. (2012). A collaborative project of UMass Lowell and Machine Science Inc. Retrieved from http://www.icodeproject.org/mod/resource/view.php?id=964

Inkscape. (2012). A vector-drawing tool: Overview. Retrieved from https://launchpad.net/inkscape

Ioannidou, A., Reppenning, A., & Zola, J. (1998). Posterboards or Java applets? In A. Bruckman, M. Guzdial, J. Kolodner, & A. Ram (Eds.), *Proceedings of the International Conference on the Learning Sciences*, Atlanta, GA.

Irwin, R. L., & Reynolds, J. K. (2010). The educational imagination revisited. *Curriculum Inquiry*, *40*(1), 155-166.

Ito, M. (2007). Foreword. In K. Salen (Eds.), *The ecology of games: Connecting youth, games, and learning*. The John D. and Catherine T. MacArthur Foundation Series on Digital Media and Learning. Cambridge, MA: MIT Press.

Ito, M., Baumer, S., Bittanti, M., Boyd, D., Cody, R., Herr-Stephenson, B., & Horst, H. (2009). *Hanging out, messing around, geeking out: Living and learning with new media*. Cambridge, MA: MIT Press.

Ito, M., Davidson, C., Jenkins, H., Lee, C., Eisenberg, M., & Weiss, J. (2008). Foreword. In A. Everett (Ed.), *Learning race and ethnicity* (pp. ix). The John D. and Catherine T. MacArthur Foundation Series on Digital Media and Learning. Cambridge, MA: The MIT Press.

Internet World Stats. (2010). Internet usage statistics, the Internet big picture: World Internet users and population stats. Retrieved from http://www.internetworldstats.com/stats.htm

Jaeger, P. T., & Burnett, G. (2010). *Information worlds: Social context, technology and information behavior in the age of the Internet*. New York, NY: Routledge.

Jang, H. (2008). Supporting students' motivation, engagement, and learning during an uninteresting activity. *Journal of Educational Psychology*, *100*(4), 798-811.

Jarvis, P., Holford, J., & Griffin, C. (1998). *The theory and practice of learning*. London, United Kingdom: Kogan Page.

Jenkins, H. (2006a). *Confronting the challenges of participatory culture: Media education for the 21st century* (Pt. 1). Confessions of an Aca-Fan - The official weblog of Henry Jenkins [Archives]. Retrieved from http://www.henryjenkins.org/2006/10/confronting_the_challenges_of.html

Jenkins, H. (2006b). *Convergence culture: Where old and new media collide*. New York, NY: New York Press.

Jenkins, H. (2006c). *Media literacy – Who needs it?* Paper presented at the New Media Conference. Honolulu, Hawaii. Retrieved from http://www.drs.de/fileadmin/Baukasten/FM/dateien/Medienreferenntinnen/Jenkins__Henry__2006__-_Media_Literacy.._Who_Needs_It_.pdf

Jenkins, H., Clinton, K., Purushotma, R., Robison, A. J., & Weigel, M. (2009). *Confronting the challenges of participatory culture: Media education for the 21st*

century. The John D. and Catherine T. MacArthur Foundation Series on Digital Media and Learning. Chicago, IL: The MacArthur Foundation.

Jensen, J. F. (1998). "Interactivity": Tracking a new concept in media and communication studies. *Nordicom Review*, *19*(1), 185-204.

Jeremy. (2009, November 13). Next media's apply action on news [Web log comment]. Retrieved from http://tw.myblog.yahoo.com/jeremy-3c/article?mid=34524

Johnson, D. (2009). *Connections for learning: Schools and the educational use of social networking.* Saywire, Fountain Hills, AZ: Harver Group.

Johnson, L., Levine, A., & Smith, R. (2009). *The 2009 Horizon Report*. Austin, TX: New Media Consortium.

Jones, R. D. (2008). *Strengthening student engagement.* International Center for Leadership in Education. Retrieved from http://www.leadered.com/pdf/strengthen%20student%20engagement%20white%20paper.pdf

Jones, J. G., & Bronack, S. C. (2008). Rethinking cognition, representation and processes in 3D online social environments. In P. C. Rivoltella (Ed.), *Digital literacy: Tools and methodologies for the information society* (pp. 176-206). London, United Kingdom: IGI.

Jump Learning Lab. (2012). About the Rotman School of Management. In *About this learning lab*. Retrieved from http://www.learninglab.jumpassociates.com/?page_id=2

Jung, J. Y., Qui, J. L., & Kim, Y. C. (2001). Internet connectedness and inequality: Beyond the "divide." *Communication Research*, *28*(4), 507-535.

Kafai, Y. B. (1995). *Minds in play: Computer game design as a context for children is learning*. Mahwah, NJ: Erlbaum.

Kafai, Y. B. (2006). Playing and making games for learning: Instructionist and constructionist perspectives for game studies. *Games and Culture*, *1*(1), 36-40.

Kafai, Y. B. (under revision). The development of mindful practice in software design projects. Manuscript under revision for publication.

Kafai, Y. B., Ching, C. C., & Marshall, S. (1997). Children as designers of educational multimedia software. *Computer and Education*, *29*, 117-126.

Kafai, Y. B., Peppler, K. A., Alavez, M., & Ruvalcaba, O. (2006). *Seeds of a computer culture: An archival analysis of programming artifacts from a community technology center. Proceedings of the 2006 International Conference of the Learning Sciences,* Bloomington, IN.

Kafai, Y. B., & Peppler, K. A. (2007). *What video game making can teach us about literacy and learning: Alternative pathways into participatory culture.* Proceedings of the Third International Conference of the Digital Games Research Association (DiGRA) (pp. 369-376), University of Tokyo, Japan.

Kafai, Y. B., & Resnick, M. (1996). *Constructionism in practice: Designing, thinking, and learning in a digital world.* Mahwah, NJ: Lawrence Erlbaum.

Kafai, Y. B., & Yarnall, L. (1996, April). *Issues in project-based science activities: Children's constructions of ocean software games.* Paper presented at the annual meeting of the American Educational Research Association, New York, NY.

Katz, J. E., & Aakhus, M. (Eds.). (2002). *Perpetual contact: Mobile communication, private talk, public performance*. Cambridge, United Kingdom: Cambridge University Press.

Kauffman, D., & Hussman, J. (2004). Effects of time perspective on student motivation: Introduction to a special issue. *Educational Psychology Review*, *16*(1), 1–7.

Kaufman, J. C., Plucker, J. A., & Baer, J. (2008). *Essentials of creativity assessment*. Hoboken, NJ: Wiley.

Kaur, A. (2010). *How e-mail works* [Slideshare.net]. Retrieved from http://www.slideshare.net/adkpcte/how-email-works

Kay, A. C. (1990). User interface: A personal view. In B. Laurel (Ed.), *The art of human-computer interface design* (pp. 191-207). Reading, MA: Addison-Wesley.

Kellner, D. (2000). New technologies/new literacies: Reconstruction education for the new millennium. *Teaching Education*, *11*(3), 245-265.

Kellner, D., & Share, J (2005). Toward critical media literacy: Core concepts, debates, organizations and policy. *Discourse: Studies in the Cultural Politics of Education*, *26*(3), 369-389.

Kellner, D., & Share, J. (2007). Critical media literacy, democracy, and the reconstruction of education. In D. Macedo & S. R. Steinberg (Eds.), *Media literacy: A reader* (pp. 3-23). New York, NY: Peter Lang.

Kirschner, P. A., & Erkens, G. (2006). Cognitive tools and mindtools for collaborative learning. *Journal of Educational Computing Research*, *35*(2), 199-209.

Klopfer, E., Osterweil, S., Groff, J., & Haas, J.(2009). *Using the technology of today, in the classroom today: The instructional power of digital games social networking simulations and how teachers can leverage them*. Cambridge, MA: MIT Press. Retrieved from http://education.mit.edu/papers/GamesSimsSocNets_EdArcade.pdf

Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teacher College Record*, *108*(6), 1017-1054.

Kolbitsch, J., & Maurer, H. (2006). Community building around encyclopaedic knowledge. *Journal of Computing and Information Technology*, *14*(3), 175-190. Retrieved from http://cit.zesoi.fer.hr/browsePaper.php?paper=706

Kolodner, J., Crismond, D., Gray, J., Holbrook, J., & Putembakar, S. (1998). Learning by design: From theory to practice. In A. Bruckman, M., Guzdial, J., Kolodner, & A. Ram (Eds.), *Proceedings of the International Conference on the Learning Sciences* (pp. 16-22), Atlanta, GA.

Kongrith, K., & Maddux, C. D. (2005). Online learning as a demonstration of Type II technology: Second-language acquisition. *Computers in the Schools*, *22*(1-2), 97-111.

Kressel, H., & Lento, T. V. (2007). *Competing for the future: How digital innovations are changing the world.* Cambridge, United Kingdom: Cambridge University Press.

Kung, L., Picard, R. G., & Towse, R. (2008a). Introduction. In L. Kung, R. G. Picard, & R. Towse (Eds.), *The Internet and the mass media* (pp. 1-16). London, United Kingdom: Sage.

Kung, L., Picard, R. G., & Towse, R. (2008b). Theoretical perspectives on the impact of the Internet on the mass media industries. In L. Kung, R. G. Picard, & R. Towse (Eds.), *The Internet and the mass media* (pp. 17-44). London, United Kingdom: Sage.

Landa, R. (2006). *Designing brand experiences*. Clifton Park, NY: Thomson Delmar Learning.

Landauer, T. (1988). Education in a world of omnipotent and omniscient technology. In R. Nickerson, & P. Zodhiates (Eds.), *Technology in education: Looking toward 2020.* Hillsdale NJ: Lawrence Erlbaum.

Latour, B. (1991). *We have never been modern*. Cambridge, MA: Harvard University Press.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation.* New York, NY: Cambridge University Press.

Lee, M., & Gaffney, M. (2008). *Leading a digital school: Principles and practice*. Victoria, Australia: ACER Press.

Lehrer, R. (1992). Authors of knowledge: Patterns of hypermedia design. In S. Lajoie & S. Derry (Eds.), *Computers as cognitive tools*. Mahwah, NJ: Erlbaum.

Lenhart, A., Madden, A., Smith, A., Purcell, K., Zickuhr, K., & Rainie, L. (2011). Teens, kindness and cruelty on social network sites. Pew Internet. Retrieved from http://pewinternet.org/Reports/2011/Teens-and-social-media/Summary/Findings.aspx

Lewis, C. (2007). New literacies. In C. Lankshear & M. Knobel (Eds.), *A new literacies sampler* (pp. 229-238). New York, NY: Peter Lang.

Levy, P. (1997). *Collective intelligence: Mankind's emerging world in cyberspace*. New York, NY: Perseus.

Levy, P. (2001). *Cyberculture*. Minneapolis: University of Minnesota.

Li, Q., & Akins, M. (2004). Sixteen myths about online teaching and learning in higher education: Don't believe everything you hear. *TechTrends, 49*(4), 51-60. doi: 10.1007/BF02824111

Libbey, H. P. (2004). Measuring student relationships to school: Attachment, bonding, connectedness, and engagement. *Sociology of Education*, *68*, 241-271.

linear thinking. (n.d.). *Dictionary.com's 21st century lexicon*. Retrieved from Dictionary.com website: http://dictionary.reference.com/browse/linear thinking

Logo Foundation. (2011). What is Logo? Retrieved from http://el.media.mit.edu/logo-foundation/logo/index.html

Lombana, A. (2008). *Results tagged "presentation programming online community" from webtech clone of new media literacies* (Project: New Media Literacies). New Media Literacies Research Group. Retrieved from http://newmedialiteracies.org/MT/mt-search.cgi?IncludeBlogs=23&tag=presentation%20programming%20online%20community&limit=20

Longworth, N., & Davies, W. K. (1996). Lifelong learning. *Biochemical education*, *25*(1), 179.

Ma, J. (2009, October 26). Small is beautiful. *The New York Times*. Retrieved from http://www.nytimes.com/2009/10/27/opinion/27iht-edma.html

Mayes, T., & de Freitas, S. (2007). Review of e-learning theories, frameworks and models. *JISC e-Learning Models Desk Study*. Retrieved from http://www.jisc.ac.uk/uploaded_documents/Stage%202%20Learning%20Models%20(Version%201).pdf

McLeod, J., & Cropley, A. (1989). *Fostering academic excellence*. Oxford, United Kingdom: Pergamon Press.

McLuhan, H. (1964). *Understanding media: The extensions of men*. New York, NY: New American University.

Mears, C. L. (2005), *Experiences of Columbine parents: Finding a way to tomorrow*. Doctoral dissertation, University of Denver.

Mehra, B. (2002). Bias in qualitative research: Voices from an online classroom. *The Qualitative Report*, *7*(1, March). Retrieved from http://www.nova.edu/ssss/QR/QR7-1/mehra.html

Mennecke, B. E., & Strader, T. J. (2003). *Mobile commerce: Technology, theory, and applications*. Hershey, PA: IGI.

Miletta, A., & Miletta, M. M. (2008). *Classroom conversation: A collection of classics for parents and teachers*. New York, NY: The New Press.

Miller, D. (2008). *Teaching with intention: Defining beliefs, aligning practice, taking action, K-5*. Portland, ME: Stenhouse.

Moneta, G. (2004). The flow model of intrinsic motivation in Chinese: Cultural and personal moderators. *Journal of Happiness Studies*, *5*(2), 181–217.

Morcellini, M. (2008). Digital media and socialization. In P. C. Rivoltella (Ed.), *Digital literacy: Tools and methodologies for information society* (pp. 45-66). Hershey, PA: IGI.

Mossberger, K., Tolbert, C. J., & McNeal, R. S. (2008). *Digital citizenship: The Internet, society, and participation*. Cambridge, MA: MIT Press.

Mueller, J., Wood, E., & Willoughby, T. (2008). The integration of computer technology in the classroom. In E. Wood & T. Willoughby (Eds.), *Children's learning in a digital world* (pp. 272-292). Malden, MA: Blackwell.

Murphie, A., & Potts, J. (2003). *Culture and technology*. New York, NY: Palgrave Macmillan.

Nickerson, R. S. (1988). Preface. In R. S. Nickerson & P. P. Zodhiates (Eds.), *Technology in education: Looking toward 2020* (pp. 285-317). Hillsdale, NJ: Lawrence Erlbaum.

Nolan, R. W. (1999). *Communicating and adapting across cultures: Living and working in the global village*. Westport, CT: Bergin & Garvey.

Nolen, S. B., & Haladyna, T. M. (1990). Personal and environmental influences on students' beliefs about effective study strategies. *Contemporary Educational Psychology*, *15*(2), 116-130.

Oppenheimer, T. (2003). *The flickering mind: Saving education from the false promise of technology.* New York, NY: Random House.

O'Reilly, T. (2005). *What is Web 2.0?* O'Reilly Network. Retrieved from http://oreilly.com/web2/archive/what-is-web-20.html

Ornstein, A. C., & Hunkins F. P. (1988). *Curriculum: Foundations, principles, and issues.* Boston, MA: Pearson Education.

Orr, M., & Fankhauser, R. (1996). *Approaches to research in a digital environment – Who are the new researchers?* Select paper from EdTech '96 Biennial Conference of the Australian Society for Educational Technology, Melbourne, Australia.

Palfrey, J., & Gasser, U. (2008). *Bone digital.* Philadelphia, PA: Basic Books.

Palmer, D. J. (1965). *The rise of English studies: An account of the study of the English language and literature from its origins to the making of the Oxford English school*. New York, NY: Oxford University Press.

Papert, S. (1980). *Mindstorms: Children, computers and powerful ideas*. New York, NY: Basic Books.

Papert, S. (1993). *The children's machine: Rethinking school in the age of the computer*, New York, NY: Basic Books.

Pavlik, J. V. (2008). *Media in the digital age*. New York, NY: Columbia University Press.

Pelgrum, W. J. (1992). International research on computers in education. *Prospects*, *22*, 341-349.

Pew Internet & American Life Project. (2010). *The rise of apps culture*. Project of the PewResearchCenter. Retrieved from http://pewinternet.org/~/media//Files/Reports/2010/PIP_Nielsen%20Apps%20Report.pdf

Phalet, K., Andriessen, I., & Lens, W. (2004). How future goals enhance motivation and learning in multicultural classrooms. *Educational Psychology Reviews, 16*(1), 59-89.

Piaget, J., & Inhelder, B. (1967). The coordination of perspectives. In *The child's conception of space* (pp. 209-246). New York, NY: Norton.

Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning component of classroom academic performance. *Journal of Educational Psychology*, *82*(1), 33-40.

Plowman, L., Stephen, C., & McPake, J. (2010). *Growing up with technology: Young children learning in a digital world*. New York, NY: Routledge.

Pong Game. (2012). About Pong. Retrieved from http://www.ponggame.org/

Powell, W. W. (2004). The knowledge economy. *Annual Review of Sociology*, *30*, 199–220. doi: 10.1146/annurev.soc.29.010202.100037

Prensky, M. (2001). Digital native, digital immigrants. *On the Horizon*, *9*(5), 1-6.

Prensky, M. (2006). *Don't bother me Mom I am learning!: How computer and video games are preparing your kids for 21st century success and how you can help.* St. Paul, MN: Paragon House.

Press, A. L., & Williams, B. A. (2010). *The new media environment: An introduction*. West Sussex, United Kingdom: Wiley-Blackwell.

Quest Atlantis. (2012). Maintained as part of the Atlantis Remixed Project, an international learning and teaching project. Retrieved from http://atlantisremixed.org/

Rau, P. P., Gao, Q., & Wu, L. (2006). Using mobile communication technology in high school education: Motivation, pressure and learning performance. *Computer & Education, 50*(1), 1-22.

Resnick, M. (2002). Rethinking learning in the digital age. In G. Kirkman (Ed.), *The global information technology report: Readiness for the networked world* (pp. 32-37). Oxford, United Kingdom: Oxford University Press.

Resnick, M. (2006). Computer as paintbrush: Technology, play, and the creative society. In D. Singer, R. Golinkoff, & K. Hirsh-Pasek (Eds.), *Play = learning: How play motivates and enhances children's cognitive and social-emotional growth*. New York, NY: Oxford University Press.

Resnick, M. (2007a, June). All I really need to know (about creative thinking) I learned (by studying how children learn) in kindergarten. *Proceedings of the 6th ACM SIGCHI Conference on Creativity & Cognition* (pp. 1-6), Washington, DC, USA.

Resnick, M. (2007b). Sowing seeds to a more creative society. *International Society for Technology in Education*, December/January, 18-22.

Resnick, M. (2009). Scratch: Programming for all. *Communications of the ACM*, *52*(11).

Rhodes, P. J. (1994). Race-of-interviewer effects: A brief comment. *Sociology, 28*(2), 547-558.

Richard, V., & Teehan, K. (2007). *Peering into technology coaching: Meeting 21st century teacher needs.* Chesapeake, VA: Society for Information Technology and Teacher Education (SITE).

Richardson, V. (2003). Constructivist pedagogy. *Teachers College Record*, *105,* 1623-1640.

Richtel, M. (2010, June 7). Attached to technology and paying a price. *The New York Times*, A1. Retrieved from http://www.nytimes.com/2010/06/07/technology/07brain.html

Rivoltella, P. C. (2008). From media education to digital literacy: A paradigm change? In P. C. Rivoltella (Ed.), *Digital literacy: Tools and methodologies for information society* (pp. 26-44). Hershey, PA: IGI.

Rojvithee, A. (2005, October) *Introduction and definition of lifelong learning*. Paper presented at the Global Forum on Education: The Challenges for Education in a Global Economy, Organisation for Economic Co-operation and Development [OECD] and the Chilean Ministry of Education, Santiago, Chile. Retrieved from www.oecd.org/dataoecd/62/2/35469178.pdfb

Roland. C. (2007, August). *2nd annual Internet survey for art teachers: The results*. Retrieved from http://www.artjunclion.org/atgi/teachers/Internet_surveyO7.html

Rosen, L. D. (2010a). *Rewired : Understanding the iGeneration and the way they learn*. New York, NY: Palgrave Macmillan.

Rosen, L. (2010b). Understanding the iGeneration – Before the next mini-generation arrives. *Nieman Reports*, Summer. Retrieved from http://www.nieman.harvard.edu/reportsitem.aspx?id=102405

Rosenblatt, L. M. (1978). *The reader, the text, the poem: The transactional theory of the literary work*. Carbondale: Southern Illinois University Press.

Ross, D. D. (2005). An introduction to curriculum criticism. In R. R. Sherman & R. B. Webb (Eds.), *Qualitative research in education: Focus and methods* (pp. 161-174). New York, NY: Routledge.

Roth, W. M. (1995). Inventors, copycats and everyone else: The emergence of shared resources and practices as defining aspects of classroom communities. *Science Education*, *79*, 475-502.

Roussou, M. (2004). Learning by doing and learning through play: An exploration of interactivity in virtual environments for children. *ACM Journal of Computers in Entertainment 2*(1), 1-23.

Rubin, H. J., & Rubin, I. S. (2005). *Qualitative interviewing: The art of hearing data.* Thousand Oaks: CA: Sage.

Saettler, P. (1990). *The evolution of American educational technology*. Englewood, CO: Libraries Unlimited.

Scardamalia, M., & Bereiter, C. (2006). Knowledge building: Theory, pedagogy, and technology. In K. Sawyer (Ed.), *Cambridge handbook of the learning sciences* (pp. 97-118). New York, NY: Cambridge University Press.

Schofield, J. W. (1995). *Computer and classroom culture*. New York, NY: Cambridge University Press.

Schrum, L. (1999). Technology developments, for educators: Where are we going and how do we get there? *Educational Technology Research and Development, 47*(4), 83-90.

Schrum, L., & Levin, B. B. (2009). *Leading 21st century schools: Harnessing technology for engagement and achievement*. Thousand Oaks, CA: Corwin Press.

Second Life. (n.d.). What is Second Life? Retrieved from http://secondlife.com/whatis/?lang=en-US

Seely Brown. J., & Adler, R. (2008). Minds on fire: Open education, the long tail and learning 2.0. *Educause Review*, *43*(1), 16-32.

Seidman, I. (1998). *Interviewing as qualitative research: A guide for researchers in education and the social sciences* (2nd ed.). New York, NY: Teachers College Press.

Shaffer, D. W. (1997). Design, collaboration and computation: The design studio as a model for computer-supported collaboration in mathematics. *CSCL*, 250-255.

Shaffer, D. W. (2004). *Epistemic frames and islands of expertise: Learning from infusion experiences.* Paper presented at the International Conference of the Learning Sciences (ICLS), Santa Monica, CA.

Shaffer, D. W. (2006). *How computer games help children learn*. New York, NY: Macmillan.

Shaffer, D. W., & Gee, J. P. (2005). Before every child is left behind: How epistemic games can solve the coming crisis in education (Working Paper, 2005-7). Madison: Wisconsin Center for Education Research.

Shaffer, D. W., & Resnick, M. (1999). “Thick” authenticity: New media and authentic learning. *Journal of Interactive Learning Research*, *10*(2), 195-215.

Shaffer, D. W., Squire, K. R., Halverson, R., & Gee, J. P. (2004). Video games and the future of learning. Educause website. Retrieved from http://www.educause.edu/Resources/VideoGamesandtheFutureofLearni/153925

Sharkey, J., & Brandt, D. S. (2008). Integrating technology literacy and information literacy. In P. C. Rivoltella (Ed.), *Digital literacy: Tools and methodologies for information society* (pp. 85-97). Hershey, PA: IGI.

Sharpe, R. & Beetham, H. (2010). Understanding students’ uses of technology for learning: Towards creative appropriation. In R. Sharpe, H. Beetham, & S. de Freitas (Eds.), *Rethinking learning for a digital age: How learners are shaping their own experience* (pp. 85-99). New York, NY: Routledge.

Sharpe, R., Beetham, H., de Freitas, S., & Conole, G. (2010). An introduction to rethinking learning for a digital age. In R. Sharpe, H. Beetham, & S. de Freitas (Eds.), *Rethinking learning for a digital age: How learners are shaping their own experience* (pp. 1-12). New York, NY: Routledge.

Sharma, P. (2010). *Core characteristics of Web 2.0 services.* TechPluto. Retrieved from http://www.techpluto.com/web-20-services/

Shirky, C. (2008). *Here comes everybody: The power of organizing without organizations*. New York, NY: Penguin.

Shuler, C. (2009). *Pockets of potential: Using mobile technologies to promote children's learning* [Report] [The innovative educator blogspot]. Retrieved from http://theinnovativeeducator.blogspot.com/2009/02/pockets-of-potential-using-mobile.html

Siraj-Blatchford, I., & Sylva, K. (2004). Researching pedagogy in English pre-schools. *British Educational Research Journal*, *30*(5), 713-730.

Sirasoontorn, P. (2009). Economic analysis of business model for delivering mobile value-added services in Thailand. Lirne, Asia. Retrieved from http://lirneasia.net/wp-content/uploads/2008/05/Mobile2.0_valueadded_services.pdf

Smith, M. K. (2005). Elliot W. Eisner, connoisseurship, criticism and the art of education. *The encyclopaedia of informal education*. Retrieved from http://www.infed.org/thinkers/eisner.htm

Sproull, L. & Kiesler, S. (1991). *Connections: New ways of working in the networked organization*. Cambridge, MA: MIT Press.

Srivastava, L. (2006). Mobile mania, mobile manners. *Knowledge, Technology & Policy*, *19*(2, Summer), 7-16.

Stern, D. (1997). What are we learning? In D. Stern & G. L. Huber (Eds.), *Active learning for students and teachers: Reports from eight countries* (pp. 183-188). New York, NY: Peter Lang.

Sternberg, R. J., & Lubart, T. I. (1995). *Defying the crowd: Cultivating creativity in a culture of conformity*. New York, NY: Free Press.

Stone, B. (2010, January 10). The children of cyberspace: Old fogies by their 20s. *The New York Times*, WK5. Retrieved from http://www.nytimes.com/2010/01/10/weekinreview/10stone.html

Sumara, D. J. (1996). *Private readings in public: Schooling the literacy imagination*. New York, NY: Peter Lang.

Sutton, B. B. (2006). *Scratch the surface of creativity: Educational tools on the web can help.* Edutopia.org. Retrieved from http://www.edutopia.org/scratching-surface-creativity

Tapscott, D. (1998). *Growing up digital: The rise of the net generation*. Columbus, OH: McGraw-Hill.

Tapscott, D. (2009). *Grown up digital: How the net generation is changing your world*. Columbus, OH: McGraw-Hill.

Tapscott. D., & Williams, A. D. (2006). *Wikinomics: How mass collaboration changes everything*. London, United Kingdom: Penguin.

Taylor, P. G., & Carpenter, B. S., II (2007). Mediating art education: Digital kids, art, and technology. *Visual Arts Research*, 92-103. Board of Trustees of the University of Illinois, University of Illinois Press.

Tillander, M. (2008, April). *Beyond black boxes: New media art, identity, and translations*. Paper presented to the National Art Education Association, New York, NY.

Trilling, B., & Fadel, C. (2009). *21st century skills: Learning for life in our times*. San Francisco, CA: John Wiley & Sons.

Trippi, J. (2005). *The revolution will not be televised: Democracy, the Internet, and the overthrow of everything*. New York, NY: Regan Books.

Trousas, C. A. (2009). *Teacher artistry and the not-so-still life of arts-centered school reform* (Unpublished doctoral dissertation). University of Denver, CO.

Tyler, R. W. (1949). *Basic principles of curriculum and instruction*. Chicago, IL: University of Chicago.

Uhrmacher, P. B. (1991). *Waldolf schools marching quietly unheard* (Unpublished doctoral dissertation). Stanford University, Stanford, CA.

Uhrmacher, P. B. (2009). Toward a theory of aesthetic learning experiences. *Curriculum Inquiry*, *39*(5), 613-636.

USA Today. (2006). Gaming: Nintendo hopes Wii spells winner. Retrieved from http://www.usatoday.com/tech/gaming/2006-08-14-nintendo-qa_x.htm

Vaegs, T., Dugosija, D., Hackenbracht, S., & Hannemann, A. (2010). Learning by gaming: Facts and myths. *International Journal of Technology Enhanced Learning*, *2*(1-2), 21-40.

Van Eck, R. (2006). Digital game-based learning: It's not just the digital natives who are restless. *Educause Review*, *41*(2), 16-30. Retrieved from http://www.educause.edu/ero/article/digital-game-based-learning-its-not-just-digital-natives-who-are-restless

Viken, A. (2009). *The history of personal digital assistants 1980-2000.* Agile Mobility website. Retrieved from http://agilemobility.net/2009/04/the-history-of-personal-digital-assistants1/

Vygotsky, L. S. (1978). *Mind in society*. Cambridge, MA: Harvard University Press.

Walker, S., Jameson, J., & Ryan, M. (2010). Skills and strategies for e-learning in a participatory culture. In H. Beetham, S. De Freitas, & R. Sharpe (Eds.), *Rethinking learning for a digital age: How learners are shaping their own experience* (pp. 212-224). New York, NY: Routledge.

Wallace, L. (2010). Multicultural critical theory: At b-school? *The New York Times*, Sunday Business, pp. 1, 7.

Wallis, C. (2006, March 24). genM: The multitasking generation. *Time*, TimeFrames, pp. 1-9. Retrieved from http://www.time.com/time/magazine/article/0,9171,1174696-9,00.html

Web 2.0. (2011). CompuGain website (an information technology and business consulting firm). Retrieved from http://www.compugain.com/taxonomy/term/43/0

Wellington, J. (2001). Exploring the secret garden: The growing importance of ICT in the home. *British Journal of Educational Technology*, *32*(2), 233-244.

Wellman, B. (2001). Physical place and cyberplace: Changing portals and the rise of networked individualism. *International Journal of Regional Research*, *25*(2), 227-252.

Werner, J. P. (2007). *Immersive installation art: Digital technology, its philosophies and the rise of a new genre in fine art* (Unpublished doctoral dissertation). Columbia University, New York.

Werquin, P. (2010). *Recognising non-formal and informal learning: Outcomes, policies and practices.* Organisation for Economic Co-operation and Development (OECD). Retrieved from http://www.cicic.ca/docs/oecd/rnfil.en.pdf

White, B., & Frederiksen, J. (1998). Inquiry, modeling and metacognition: Making science accessible to all students. *Cognition & Instruction*, *16,* 3-118.

Whittaker, S., & Sidner, C. (1996). *Email overload: Exploring personal information management of email*. Cambridge, MA: Lotus Development Corp.

Wikipedia. (2012), Google Docs. Retrieved from http://en.wikipedia.org/wiki/Google_Docs

Wiske, S. (2000). A new culture of teaching for the 21st century: To maximize the benefits of technological innovation, we need to change the way we think about teaching in K-12 schools. *Education With New Technologies Community Library*, 69-77. Retrieved from http://learnweb.harvard.edu/ent/library/teaching_culture_article.pdf

Wood, D. (1997). *How children think and learn*. Oxford, United Kingdom: Wiley–Blackwell.

Wood, E., & Willoughby, T. (2008). Summary and looking ahead. In E. Wood & T. Willoughby (Eds.), *Children's learning in a digital world* (pp. 299-301). Malden, MA: Blackwell.

Wurff, V. R. (2008). The impact of the Internet on media organization strategies and structures. In L. Kung, R. G. Picard, & R. Towse (Eds.), *The Internet and the mass media* (pp. 125-148). London, United Kingdom: Sage.

Yow, V. R. (2005). *Recording oral history: A guide for the humanities and social sciences.* Walnut Creek, CA: AltaMira Press.

Zach, F., Gretzel, U., & Xiang, Z. (2010). Innovation in the web marketing programs of American convention and visitor bureaus. *Journal of Information Technology & Tourism*, *12*(1), 47-63.

Zhao, Y. (2003). *What should teachers know about technology: Perspectives and practices*. Greenwich, CT: Information Age.

Zodhiates, P. P. (1988). Preface. In R. S. Nickerson & P. P. Zodhiates (Eds.), *Technology in education: Looking toward 2020* (pp. vii-xv). Hillsdale, NJ: Lawrence Erlbaum.

Zucker, A. A. (2008). *Transforming schools with technology: How smart use of digital tools helps achieve six key education goals.* Cambridge, MA: Harvard Education Press.

APPENDIX A

Teacher Interview Guide

This is the guide I will use in the formal interview with digital media technology teachers. The following is a general outline to assist me in asking questions to the teachers. I wish to understand more about teachers' perspectives in teaching a digital media class and the resulting students' learning experience. Further, I expect that teachers will also want to discuss with me, directly or indirectly, about issues important to them and their work.

In the context of digital media technology class, I will explore the following:

1. Can you tell me a little bit about this project please?
2. What are you hoping your students will learn in this project?
3. What are your objectives for this course?
4. What steps do you follow to design the project?
5. What are most of your students' technology skill level before working on this project?
6. What kind of materials and tools did your students use in this project?
7. How did your students choose the topic for the project?
8. Did your students use any sketchbook? If so, what did they sketch? If not, why not?
9. What were your students' favorite things to do in the project?
10. What kinds of challenges did your students have in this project?
11. What helped your students to think outside the box?
12. Have your students ever lost interest with this project? If so, why and what did they do to rekindle their interest and enthusiasm? If no, why not? Please share this reason with me.

13. Can you describe your students' level of engagement during this project please?
14. How often did you discuss the project with the students?
15. How did you teach this project?
16. What did your students do if any of them had a hard time applying an idea to the computer?
17. Can you describe a typical day or week while doing this project please?
18. Do you think the 4-week length of the course is too long or too short?
19. Can you describe how time affected students' experiences through this project?
    - From the beginning, while in work process, to their final work.
20. What do you think your students have learned in the project?
21. What are you most proud of when you think about your students experience in this project?
22. How has your students' project been meaningful?
23. Are your students happy with the project? Why or why not?
24. What do you think is the difference between working on the computer and using pen and paper?
25. Can you describe what kinds of activities your students do outside of this class that are related to this project (i.e. homework, clubs, or other activities)?
26. What is your definition of creativity?
27. Do you have anything else you would like to add?

APPENDIX B

Student Interview Guide

I will use this guide for the formal interview with students who attend the digital media technology class. The following is a general outline to assist me in asking questions to the students. Further, I expect that students will also want to discuss with me, directly or indirectly, about issues important to them and their work.

In the context of digital media technology, we will explore the following:

1. Can you tell me a little bit about this project please?
2. What are you hoping to learn in this project?
3. What is your technology skill level before working on this project?
4. What kinds of materials and tools did you use in this project?
5. How did you choose the topic for the project?
6. Did you use any sketchbook? If so, what did you sketch? If not, why not?
7. What were your favorite things to do in the project?
8. What kinds of challenges did you have in this project?
9. What helped you to think outside the box?
10. Have you ever lost interest with your project? If so, why and what did you do to rekindle the interest and enthusiasm? If no, why not and please share this reason with me.
11. Can you describe your level of engagement during this project please?
12. How often did you discuss your project with the teacher and other students?
13. How did the teacher teach this project?
14. What did you do if you had a hard time applying an idea to the computer?
15. Can you describe a typical day or week while doing this project please?

16. What do you think about the 4-weeks length course is too long or too short?
17. Can you describe how time affected your experiences through this project? From the beginning, while in work process, to your final work.
18. What do you think you have learned in the project?
19. What do you think your fellow students have gained in this project?
20. What are you most proud of when you think about your experience in this class?
21. How has your project been meaningful to you?
22. Are you happy with your project? Why or why not?
23. What do you think is the difference between working on the computer and using pen and paper?
24. Can you describe what kinds of activities you do outside of this class that are related to this project (i.e., homework, clubs, or other activities)?
25. What is your definition of creativity?
26. Do you have anything else you would like to add?

APPENDIX C

Introduction Letter

Dear Parents,

My name is Ming-tso, "Jemmy," Chien and I am a Ph.D. student in the Morgridge Department of Education, University of Denver. Presently, I am working on my dissertation and the topic is: *Digital Media's Transformative Role: Beyond Potential to Essential.* I am supervised by Dr. P. Bruce Uhrmacher, Ph.D., Director of the Department of Curriculum and Instruction at University of Denver.

The purpose of my study is to describe and analyze how the implementation of digital media curriculum may contribute to middle school students' interaction with the entire educational process. The study will be expressed by a detailed description and comprehensive examination of how middle school teachers in Denver plan and design their digital media course(s) in a cohesive and organized fashion. I want to know how students succeed using a curriculum of digital media study. The report will also look at why digital media study has value in facilitating students' commitment towards lifelong learning.

I will begin with an informal introductory talk so students are not surprised as to why I am sitting in their classroom. I would also like to let you understand my participation in your child's digital media technology class for the duration of one project over 3 to 4 weeks. During the general observation phase of my work, I will sit in the rear of the classrooms strictly for observation. During this phase, I will not interact in any way with the classroom teaching and learning. Students will be encouraged to come and talk with me to share their thoughts and processes or ask any questions after class without any influence or bearing on their work in school. My primary function will be to observe and record the experience of the teachers and students in the classrooms and their interactions with each other, the digital media curriculum, and the digital technology environment. There will be no physical contact; no testing; and no psychological examination, testing, or research during my study in your child's digital media technology class.

I will select 4 students from the class to participate in an interview process and this selection will be based on input from the teachers. The aim of the formal interview is to listen to and understand their personal voices as they express their relationships with a digital medial project. Formal interviews will be conducted with the teacher and four participating students at each site one week after they finish a specific project. The child will be made aware that participation in the program is completely voluntary; that it will have no impact on his or her grade; and participation, identity, and answers are solely for my use and in the framework of this research and will, at all times, be strictly confidential to me.

To establish classroom and environment context, I may take some photographs and/or video-tape of the classroom and of students at work and during the interviewing process. There will be no identification of any students in these images nor will they be published online or in any publication, because they are solely for background and perspective. I will seek to index these images, as best as I am able, with the names of individual students and these data will be restricted to my use. I will contact parents and students for whom a photograph may be used for publication and stress that there is no intent to identify any student, because these images are only for the purpose of establishing the conditions within the classroom.

If you have any question about this study, you may contact either Ming-tso, "Jemmy," Chien at 303.565.7197 or Jemmy.Chien@du.edu, or Dr. P. Bruce Uhrmacher at 303.871.2483 or Bruce.Uhrmacher@du.edu. Thank you so much.

Sincerely,

Ming-tso, "Jemmy," Chien

APPENDIX D

Parental/Guardian Informed Consent Form (for child under 18)

Your child is invited to participate in a research study examining the students' experience in learning via digital media in education. This study is being conducted by Ming-tso, "Jemmy," Chien, MFA, a Ph.D. student in the Curriculum and Instruction program in the Morgridge College of Education at the University of Denver. Jemmy is supervised by Dr. P. Bruce Uhrmacher, Ph. D., Director of Department of Curriculum and Instruction at the University of Denver. If you have any questions about this study, you may contact either Ming-tso, "Jemmy," Chien at 303.565.7197 or Jemmy.Chien@du.edu, or Dr. P. Bruce Uhrmacher at 303.871.2483 or Bruce.Uhrmacher@du.edu

Participation in this study should take about 45 minutes of your child's time. Participation will involve responding to 26 questions about your child's experience with digital media in his or her education. Participation in this project is strictly voluntary. The risks associated with this project are minimal. However, the procedures will be in place to greatly minimize this risk. If your child experiences discomfort he/she may discontinue the interview at any time. Your child's right to choose not to answer any questions that may make him/her feel uncomfortable will be respected. Refusal to participate or withdrawal from participation will involve no penalty or loss of benefits to which your child may be otherwise entitled.

To the extent possible within the requirements of applicable laws and/or the Board of Education policies, all information gathered in this research will be kept confidential. Your child's responses will be identified by code number only and will be kept separate from information that could identify him/her. This is done to protect the confidentiality of your child's responses. Only the researcher will have access to your child's individual data, and any reports generated as a result of this study will use only group averages and paraphrased wording. However, should any information contained in this study be the subject of a court order or lawful subpoena, the University of Denver might not be able to avoid compliance with the order or subpoena. Although no questions in this interview address it, I am required by law to tell you that if information is revealed concerning suicide, homicide, or child abuse and neglect, it is required by law that this be reported to the proper authorities.

If you have any concerns or complaints about how your child was treated during the interview, please contact Susan Sadler, Chair, Institutional Review Board for the Protection of Human Subjects, at 303-871-3454, or Sylk Sotto-Santiago, Office of Research and Sponsored Programs at 303-871-4052 or Paul Olk 871-4531, Institutional Review Board Chair, or write to either at the University of Denver, Office of Research and Sponsored Programs, 2199 S. University Blvd., Denver, CO 80208-2121.

You may keep this page for your records. Please sign the next page if you understand and agree to the above. If you do not understand any part of the above statement, please ask the researcher any questions you have.

Thank you so much for your interest participating in this study.

Ming-tso, "Jemmy," Chien

I have read and understand the foregoing descriptions of the study called *Digital Media's Transformative Role in Education: Beyond Potential to Essential.* I have received a satisfactory explanation of this form and I fully understand the parameters of this study. I agree to have my child participate in this study, and I understand that I may withdraw my consent at any time and I have received a copy of the consent form.

Please mark your response for each of the following items that you agree with.

I grant consent for my child to be audio recorded ○

I do not grant consent for my child to be audio recorded ○

I grant consent for my child to be videotape recorded ○

I do not grant consent for my child to be videotape recorded ○

I grant consent for my child to be photographed ○

I do not grant consent for my child to be photographed ○

____
Child's Name

____
Parent or Guardian Name (please print)

____
Parent or Guardian Signature Date

APPENDIX E

Teacher's Informed Consent Form

My name is Ming-tso, "Jemmy," Chien and I am a Ph.D. student in the Morgridge Department of Education at the University of Denver. Presently, I am working on my dissertation, and the topic is *Digital Media's Transformative Role: Beyond Potential to Essential*. I am supervised by Dr. P. Bruce Uhrmacher, Ph.D., Director of the Department of Curriculum and Instruction at the University of Denver.

Participation in this study should take about 45 minutes of your time. Participation will involve responding to 26 questions about your experience with digital media in education. Participation in this project is strictly voluntary. The risks associated with this project are minimal. If, however, you experience discomfort, you may discontinue the interview at any time. Your right to choose not to answer any questions that may make you feel uncomfortable will be respected. Refusal to participate or withdrawal from participation will involve no penalty or loss of benefits to which you are otherwise entitled.

Your responses will be identified by code number only and will be kept separate from information that could identify you. This is done to protect the confidentiality of your responses. Only the researcher will have access to your individual data, and any reports generated as a result of this study will use only group averages and paraphrased wording. However, should any information contained in this study be the subject of a court order or lawful subpoena, the University of Denver might not be able to avoid compliance with the order or subpoena. Although no questions in this interview address it, the researcher is required to tell you that if information is revealed concerning suicide, homicide, or child abuse and neglect, it is required by law that this be reported to the proper authorities.

If you have any concerns or complaints about how you were treated during the interview, please contact Susan Sadler, Chair, Institutional Review Board for the Protection of Human Subjects at 303-871-3454, or Sylk Sotto-Santiago, Office of Research and Sponsored Programs at 303-871-4052, or Paul Olk, Institutional Review Board Chair at 303-871-4531, or write to either at the University of Denver, Office of Research and Sponsored Programs, 2199 S. University Blvd., Denver, CO 80208-2121.

You may keep this page for your records. Please sign the next page if you understand and agree to the above. If there is any part of the above statement that you do not understand, please ask the researcher any questions you have.

Thank you so much for your interest in participating in this study.

Ming-tso, "Jemmy," Chien

I, ___________________________________, have been invited to participate in a study of digital media technology education. I understand that information I provide Ming-tso, "Jemmy," Chien will be used in her dissertation research and that this study is supervised by Dr. P. Bruce Uhrmacher, Ph.D., Director of Department of Curriculum and Instruction, Morgridge College of Education at the University of Denver, 303.871.2483. My participation in this study is entirely voluntary, and I am free to withdraw my consent and participation at any time. Also, my name or personal identity will not be revealed in any written documents or oral presentations. For further information, I may call Ming-tso, "Jemmy," Chien at 303.565.7197. If I become dissatisfied with any aspect of this study, I may report grievances anonymously to the Office of Research and Sponsored Programs at the University of Denver by calling 303.871.2121.

I have read and understood the foregoing descriptions of the study called *Digital Media's Transformative Role in Education: Beyond Potential to Essential.* I have asked for and received a fully satisfactory explanation of any language or part of this form that I did not completely understand. I agree to participate in this study, and I understand that I may withdraw my consent at any time, and I have relieved a copy of the consent form.

Please mark your response for each of the following items that you agree with.

I agree to be audio recorded ○

I do not agree to be audio recorded ○

I agree to be videotape recorded ○

I do not agree to be videotape recorded ○

I agree to be photographed ○

I do not agree to be photographed ○

____

Participant's Name (please print)

____

Participant's Signature Date